GAS JOURNAL

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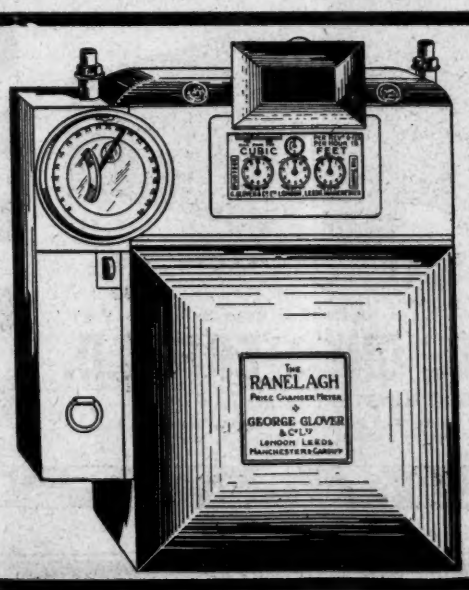

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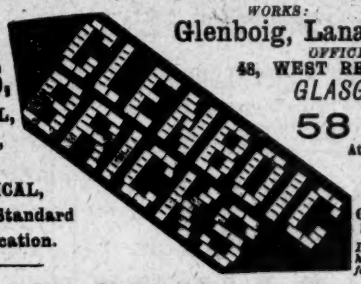

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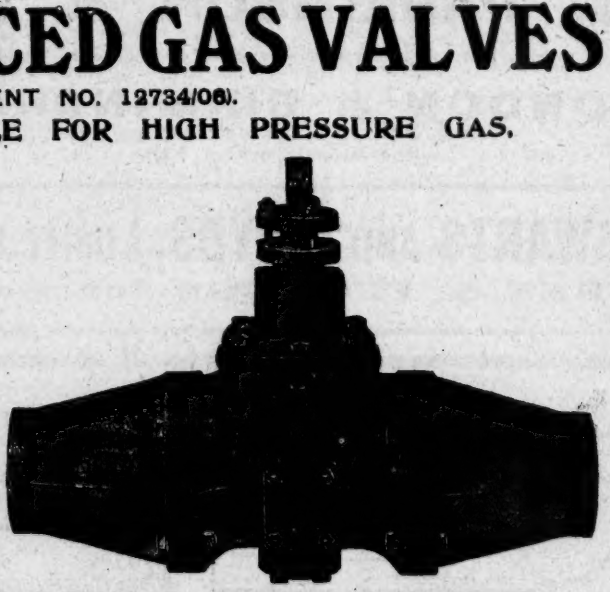

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VOL. CLIV., No. 3030.] WEDNESDAY, JUNE 8, 1921. [73RD YEAR.

EDITORIAL NOTES.

The Institution Meeting and Programme.

UPON inquiry, we learn from the Secretary of the Institution (Mr. Walter T. Dunn) that there is every prospect that a proposal will be made by the President (Mr. Thomas Goulden, M.Inst.C.E.) that the postponed annual meeting shall be held early in October—probably during the first week. Meantime, there have been liberated for publication the Presidential Address, a report on "Steaming in Vertical "Retorts" by the Director of Fuel Research (Sir George Beilby, F.R.S.) and the technical staff at the Fuel Research Station at East Greenwich, the fifth and sixth reports by the Gas Investigation Committee, and the bifurcated report by the Refractory Materials Committee on "Jointing Mate-"rials for Refractories" and the "Influence of Oxidizing "and Reducing Atmospheres on Refractory Materials." The fifth report of the Gas Investigation Committee will be particularly interesting at this time, in view of the fact that it will deal with the accuracy and general reliability under working conditions of recording calorimeters—work which has been in the capable hands of Mr. James W. Wood. The sixth report will also be highly appropriate in connection with the changes that are coming over the gas industry, as this will comprise the results of a research by Dr. Parker into the blue water-gas process, which may be regarded as complementary to the investigation of steaming in continuous vertical retorts at Uddingston. The immediate publication of these reports is a wise step, as it will give a good opportunity before the meeting for a complete study to be made of the results of the various investigations; and this should lead to full discussions upon them. The programme arranged for the meeting also included four papers, which have been reserved for the autumn conference. Mr. G. M. Gill, Chief Engineer to the South Metropolitan Gas Company, will submit a contribution on "Car-"bonization in Horizontal Retorts." Mr. J. G. Taplay, the Chemist to the Life of Gas-Meters Research Committee, will present a paper on the "External Corrosion of Services "and Mains." Mr. A. C. Monkhouse, B.Sc., the holder of the Institution Gas Research Fellowship, will, in conjunction with Prof. Cobb, submit a paper on the "Liberation of "Nitrogen from Coal and Coke as Ammonia." The Society of British Gas Industries will contribute a composite paper treating of "Tar Distillation and Sulphate of Ammonia "Manufacture." It will be seen from this brief intimation that there will be important matter of a technical nature for the consideration of the meeting; and it is quite on the cards that this programme will be supplemented by further contributions before the meeting. If not, there is quite sufficient material in hand.

The President's Address—Evolution not Revolution.

THE address that would have been delivered by the President (Mr. Thomas Goulden, M.Inst.C.E.) a fortnight ago, had not industrial troubles immediately and sternly affecting the gas industry disturbed the well-laid plans of the Council of the Institution, and caused these plans to fall before the dictates of prudence, is published in our columns to-day. Now that we have read the address, our feeling is that the act of the President in deciding upon its prompt publication rather than its retention for the autumn meeting is one that will meet with very general approval, because the address in every part is peculiarly appropriate to the day in view of the guidance and confirmation it gives to policy from the occupant of the responsible office of Chief Engineer to the largest Gas Company in the world. We have had exhortation and advice from the distinguished predecessors in the Presidential Chair of the Institution. Since then the Gas Regulation Act has been passed, with all its authorization to change and its inherent potentiality. The President to-day tells us what he thinks of it, and what, in his opinion—opinion based upon long experience, and the investigation by a cultured mind of current gas conditions and future requirements—is the correct policy to adopt at the initial stages, and which policy must conform to present circumstances. We cannot pass from present circumstances to altogether different ones by a stroke of the pen or by the word of the glib tongue. Evolution, however, will be all the more rapid by the possession of new powers and new opportunities; but evolution there must be, and not sudden revolution, which has a dislocating effect upon everything. The President assesses fully the value of the Act—not only in respect of its financial provisions, but in regard to the large opportunities it confers in relation to the new basis for the sale of gas, and the important liberty to gas undertakings to determine for themselves the calorific value of the gas they can best supply, having regard to economic production and local use. The President is an advocate for evolution on orderly lines, while not limiting himself by any definite expression of view as to what the ultimate conditions will be. The initial calorific values that are being declared under the Act show how very general is this view; and confirmation by a President holding so distinguished a professional position will be gratifying to those who have made their first move under the Act, which move does not by any means debar them, as present curtailing circumstances change in regard to producing plant, main capacity, and consumers' fittings and appliances, from still following the path of evolution, if experience justifies.

The recognition of the potentialities of the Act is not so general in technical and administrative circles as could be wished. The escape from financial hardship is the attractive feature for not a few. The change from cubic feet and a definite qualitative standard has not been appraised by many in the gas industry at its full value. It is accepted by some as a mere condition of financial revision. It is vastly more than this. The whole of our obligations are now shifted on to the "therm." The gas industry has to make therms, distribute therms, and sell therms, and this, subject to circumstances and the current conditions at any time, in the most economical manner. The provisions of the Act are, says the President, "destined to effect a complete "revolution of the conditions under which the manufacture "and supply of gas have hitherto been conducted, and that "in a considerably shorter space of time than would have "been possible by any means other than an Act such as this, "so general in its application, and of so sweeping a "character." In the securing of this uberous and liberating Act, recognition is made by the President of the indebtedness of the industry to the Executive of the National Gas Council, and particularly to the indefatigable President of that body (Mr. D. Milne Watson), for the energy, tact, and skilful persistence with which they represented the interests of the industry. It was, of course, quite an oversight that the President did not in this connection make equally prominent acknowledgment of the fundamental work of the Board of Fuel Research.

There is no sign of the abatement in the vigour of the industry. Never was there a time when more practical work was being done in it; never a time when so much earnest and skilled research work was being carried on.

The Act has enlarged the need and the scope for vigour and research, and has provided for both a valuable incentive. What is equally important, never did the public appreciate gas to the extent that it is doing to-day. Some comparative figures the President quoted are highly gratifying not only in respect of their magnitude, but in that of the relation of the percentages of consumption increase to consumer increase. Calculating from the Board of Trade returns, the President finds that in ten years the annual consumption has increased by 28·6 p.ct., while the number of consumers has advanced by 22·3 p.ct. In the case of the Gas Light and Coke Company, in the decade the consumption has been enlarged by 29·3 p.ct., and the consumers by 25·7 p.ct. These figures (as well as those he gives as to the enlarged consumption by prepayment consumers) indicate the steady but sure progress that gas is making in the displacing of coal as a fuel. It points to the most economical extension of business when the percentage increase of consumption is in advance of the percentage accession of gas consumers; and in the promotion of this healthy work, we believe fully with the President, that sale by the therm is destined to take a prominent part. In the electricity industry, there is a movement to apply the two-part tariff for the express purpose of endeavouring to develop the use of electricity for heating purposes. But we have greater confidence in the therm, which produces a basis of sale that has a real affinity to use, and upon which basis our electrical competitors dare not attempt to conduct business.

In passing, the President speaks of the advantage there would be in having an approximately uniform calorific standard throughout the country. If there could be standard value and composition, there could be standard appliances. But to attain to this end, we should want standard coal, and standard everything else. The gas industry in every quarter has to make use of the best available conditions; and it has to remember that British coal is a wasting asset, and so is American oil. He therefore disagrees with those who advocate a range of calorific value between only 450 and 500 B.Th.U., seeing that it promises but little flexibility in the methods of manufacture. Given cheaper coal and completely normal conditions, which would or might lower the demand for coke, it is easy enough to show that it is a sound commercial proposition to make more therms for sale in the form of gas per ton of coal handled. The advantage of saving coal is well demonstrated by figures supplied by the President. At the present time one of the stations of his Company, owing to the miners' strike, is sending out 48½ p.ct. of water gas; and so is distributing no less than 111 therms per ton of coal carbonized—true making less coke for sale, and using 1·1 gallons of oil per 1000 c.ft. In 1920, the Company made 35,148,709,000 c.ft. of gas, and of this 20·9 p.ct. was water gas slightly carburetted (we believe rather under a gallon of oil per 1000 c.ft. was used). The coal carbonized amounted to 2,279,250 tons; and the President says that had no water gas been made 415,750 tons more coal would have been required, while from the make of coke only 355,000 tons were needed for water-gas production. There is certainty the President does not want to claim more coal saving for water gas than facts will warrant; and we suggest to him that he has claimed rather too much. The average make of coal gas per ton being 12,196 c.ft. in 1920, we may assume that (using a round figure) 6·5 therms were produced per ton of coal. Then, if so, for the 170,471,238 therms actually supplied, 2,622,634 tons of coal would have sufficed. Deducting from this the 2,279,250 tons carbonized, the additional coal required would have been 343,384 tons, and not 415,750 tons. The change from cubic feet to therms brings us into closer harmony with facts; and the difference in calculation is merely attributable to the basis of that of the President being cubic feet and that of our own B.Th.U. Nevertheless, the 343,384 tons is not a trifle in these or any other days, in view of the costs and all that is involved.

For a start in existing circumstances, the President favours in the case of his Company a declared value of 475 B.Th.U., which will mean the making of a gas of 485 B.Th.U. He is no advocate for lowering calorific value too violently, in view of the considerable increase in specific gravity that this would occasion. This is a point that requires very careful consideration, particularly in the case of the Gas Light Company with its extensive area, and a distribution system existing under conditions which it would be very expensive to deal with to-day. Generally accepted as axiomatic will be the view of the President that—"the correct policy must surely be to maintain the "calorific value at the highest point at which the therm can "be most cheaply produced and distributed."

Our ideals whatever they may be must always be subject to practicability; but it is a good thing to have high ideals; for in them there is stimulation to higher effort. Such an ideal as Sir Dugald Clerk has set the technical men of the gas profession when he said that in a few years the majority of gas-works would be delivering to the consumer for domestic purposes in the form of gas 75 p.ct. of the whole of the heat of the coal at an average efficiency of 55 p.ct., is one which, as the President observes, will need all the energy and knowledge arising out of carefully applied technical training. It will also require persistent research work, to the value of that which is going on through the Leeds University and the Fuel Research station there is in the address richly deserved compliment and acknowledgment. Above all there is the need for highly qualified men. The industry is moving to new conditions, which will call for direction and supervision by men of cultivated capacity in many directions. With development, the old order of qualification is insufficient. But to secure competence, there must be proper monetary inducement and recognition of service; because there is not in all cases such recognition, there exists the need for the Association of Technical Gas Officials. "The branch of engineering we follow," said the President, "is one of exceeding interest and public utility." This is true. The work attracts; while unfortunately in too many instances the pay repels.

Other subjects were dealt with by the President; but we have touched on sufficient topics to show that the address is one that comes opportunely in the guidance it offers from the region of high professional capacity and from a ripe experience in exceptional circumstances.

Steaming in Verticals at the Fuel Research Station.

IT is a report of a remarkable and valuable character that had been prepared by Sir George Beilby, F.R.S., the Director of Fuel Research of the Department of Scientific and Industrial Research, for presentation at the annual meeting of the Institution; and the gas profession, when the proper time comes, will thank him cordially for it, and extend their acknowledgments to all the workers under him who have laboured with such precision and skill to obtain definite results, in order that exact conclusions may be drawn from their investigation. Though the report shows that so much ground has been covered by the work that has been done, Sir George regrets that it has not been possible to approach to completeness the conclusions to be drawn from the inquiry, or to make suggestions as to further development. Nevertheless, we thank him for what has been accomplished, because there is inestimable value in the lessons to be extracted from the report—lessons which, to an extensive industry dealing so largely as does the gas industry with and in fuel, cannot fail to help towards that economy which it is the main ambition and object of the Board of Fuel Research to do a material part to serve. We are not going to depreciate the work that the Gas Investigation Committee have been doing. Their inquiries into gas production have been well done. They have been carried out to a large extent on plant under ordinary gas-works conditions—such as the plant at Uddingston, where control, regulation, measurements, and weights cannot be realized with the same accuracy as on a plant equipped and fortified with every means for obtaining data from the gas and air supplied for heating the settings right through every stage of operation in respect of temperatures, out to the quantity and quality of products. But the one investigation provides a comparison with the other. The setting of Glover-West vertical retorts at the Fuel Research Station, with its array of means of control, represents the nearest approach to perfection in the working of vertical retorts with steaming which one can have in present circumstances of design and knowledge; and comparison between the results from it and operating under ordinary conditions point to where defect exists in the latter. The revelations of comparison direct to the lines of attaining greater perfection in daily working. Without a totally distinct unit of vertical retorts, and all the necessary testing and measuring equipment, it is unquestionable that accurate data cannot be obtained to determine possibilities of steaming. Such a unit is at the Fuel Research Station.

The introduction to the report prepared by Sir George Beilby supplies the essence of the abundant detail in the report itself. This introduction we are reprinting in full; and from the report itself some of the minor parts only have been excluded. For coals of similar characteristics to those which were the subject of experimental work at the Research Station, the results obtained in respect of the products may be taken as standard ones, under the conditions of steaming described, though not the ultimate results that might be realized with similar control and regulation, given improvement in the design of the setting with a view to the conservation of heat. It is clear that the investigators are not satisfied that the contractors for such settings have yet obtained the ultimate degree of thermal perfection that is possible, though undoubtedly this would mean additional cost; but a cost, it is believed, that would be amply repaid by the saving in fuel and better results generally. A great deal of consideration has been given by the investigators to the thermal efficiency of the setting. If one looks under the section of the report cross-headed "Suggestions for "Consideration on Practical Points," it will be seen that the waste of heat is considerable, amounting in the case of this setting of four retorts at the Research Station, with the combustion chambers maintained at a temperature of 1260° C., to about 80 p.ct. of the heat supplied when working without steam, and 67 p.ct. when 30 p.ct. of steam is added. This means that of the value of the coke consumed in the producers and boilers for a throughput of 10 tons of coal per day, there would be a daily waste of about £5 in the first case, and of £6 10s. in the second, taking the value of the coke at 37s. 6d. per ton. It would, of course, be beyond the wit of man to devise means for avoiding the whole of this waste in heat and money. Corresponding figures are given for lower working temperatures and for the Uddingston settings, in which latter case, with the combustion chambers maintained at 1210° C., the losses apparently amount to 58 p.ct. of the heat supplied without steaming, and 39 p.ct. when 22 p.ct. of steam is added.

Thus, in all the figures we see the reducing effect of steaming upon heat losses, and so fuel waste; and the figures in regard to heat waste are really better, with the lower temperature in the combustion chambers at Uddingston, than those for the smaller isolated setting at the Fuel Research Station, though not the figures as to resulting products. However, the steaming of charges is a considerable aid to the thermal efficiency of the settings. The whole report is eloquent of this. By its means an increased yield of gas is obtained from the coal without the necessity for any additional heat from the combustion chambers—in fact, it is (as the report says) necessary actually to reduce the external heat applied until the quantity of steam added becomes more than the incandescent coke can deal with without the assistance of extra heat from the combustion chambers. Regarding the heat waste, when the extent of this is realized, "it is felt that gas undertakings should do all in "their power to encourage the manufacturers of vertical "retorts to produce a more thermally efficient installation." To the investigators, it seems that lagging in some form must be resorted to for further improvement. Heavier brickwork at the benches ends would seem the simplest form, and would have a considerable effect. The losses through the cast-iron fittings and steelwork of the benches are also considerable; and such fittings and work should be reduced to the minimum. Other suggestions are made. The utilization of the heat of the flue gases for steam-raising is also commented upon; but it is clear there is no very favourable inclination at present in this direction by the authorities at the Research Station. Quite obvious is the view of the investigators that the direction of effort should be to conserve within the setting itself as much of the heat as possible, and so save on the fuel account.

This brings us to another attractive feature of the report, and that is the air-preheater which is employed in conjunction with the setting at the Research Station. This is constructed of steel tubes; and by it use is made of the heat in the flue gases. The preheater was made from a design by Sir George Beilby. In it the air for combustion is led under positive pressure through the steel tubes on its way to the usual vertical flue built into the setting; the flue gases being led across the outside of the tubes on the way to the chimney. The device is working most satisfactorily. The air is supplied to the preheater at atmospheric temperature, and leaves at 330°-390° C. Its average efficiency is 23 p.ct., corresponding to a saving of from 8·5 p.ct. to 10·5 p.ct. of the heat units in the gas supplied for combustion, which heating gas, by the way, at the Research Station is good water-gas of 300 to 310 B.Th.U, supplied from holders throwing a pressure of 3½ in. In the report there is some valuable information which will enable gas engineers to learn more about the amount of heat required for carbonizing-*cum*-steaming, and as to the heat losses from the settings. We have already seen the percentage character of the heat losses from the Research Station setting. The heat required to maintain the carbonizing temperature of the setting without any coal passing through the retorts was determined by special tests. This quantity is called the "heat equivalent" of the setting, and amounts to 12·4 therms per hour to maintain the combustion chambers at a temperature of 1260° C. It is important to the gas engineer that a knowledge of the "heat equivalent" of their settings should be obtained; and a test for this can be carried out (as explained in the report) with considerable accuracy at any gas-works.

Bearing upon this question of thermal efficiency, a point that has struck Sir George and his fellow-workers is the variation of results found in working with similar coals and under identical conditions of steaming at different works. The variations are partly due to the disuniformity of heating as between one retort and another. Coming from Sir George Beilby, who, through his connection with the shale-oil industry of Scotland, knew much about vertical retorts and steaming before ever the gas industry took them up seriously, a modestly-worded suggestion of his will, we believe, sink home, and have good effect. "May I venture "to suggest," he says, "that uniformity of heating is not an "unattainable ideal in even everyday practice"—that is, uniformity of heating as between different retorts, when the best degree of heat for the particular conditions of working and quality of coal have been determined. There is no question that in coal carbonization greater economy and better results lie in control and regulation, and in saving or utilizing as much as possible of the present heat losses.

All these matters with which we have been dealing are more or less of the secondary features of the report, and yet in relation to future progress they are of capital importance. The main object of the investigation was, of course, to obtain accurate data regarding the economic possibilities of steaming charges in vertical retorts, with the view of providing per ton of coal more therms for sale in the form of gas. In carrying out the research, the investigators sought to maintain constant conditions for each class of coal; the only variable adopted being the consumption of steam. By the way, graphic records included in the report enable anyone concerned to estimate at once up to what point it will be economical to steam in his particular case. Incidentally, the investigators show that (as has been remarked on several occasions) some coals are much more suitable for vertical retorts and steaming than others. With certain descriptions of Yorkshire coal, for example, steaming can be carried to a greater extent than with coals from certain other districts, and of different characteristics. But all coals can, of course, be utilized in vertical retorts given proper temperature conditions, and proper regulation of steaming. The figures in the report plainly illustrate that, as between different classes of coal, there are considerable differences in the amounts of the gains resulting from the steaming. And through the report, one can now speak with considerable confidence (as Sir George Beilby points out) regarding these gains, and their cost in fuel and labour. We cannot here go into particulars; they will be found set out with clearness in the highly informative Table I. The most important feature is, of course, the increase of therms in the form of saleable gas. There will be also found gains in the yields of tar and ammonia. There is some sacrifice in the quantity of the coke; but this is more than compensated for by the improved quantities of the other products. Then, again, the greatly increased turnover per retort removes the cost of labour from the debit to the credit side of the account, even if more highly skilled workers are employed. The tabulated statement gives further considerable information respecting the quantity and pressure of steam required, and other points relating thereto. Also as to the fuel necessary for heating the settings. In short, the information contained in this report is so extensive and valuable that it defies within the length of an editorial article a fair survey of it. The complete value can only be gauged by a studious consideration of the whole of the contents, outstanding from which is the charge—not deliberately ex-

pressed, but plainly there—that our carbonization practices have not been all they should have been scientifically, and because of this our standards and realizations of efficiency have not been what they should have been.

The Neglected Lighting Load.

THIS is a subject that must not be allowed to rest. Something must be done to arouse many gas undertakings from the lethargy into which they seem to have fallen in regard to their lighting load—a condition probably brought about by the somniferous influence of a good gas business being done in other directions. Lighting represented for the best part of a century practically the only business of the gas industry; it is the main trunk of the business to-day. But, as things are going with some gas undertakings, the trunk will become a fairly diminutive thing and terribly hollow, and the branches will then represent by their aggregate the main part of the business. The letters which we have recently published from Mr. W. J. Sandeman, of Croydon, and Mr. F. M'Leod, General Manager of the South Metropolitan Gas Company, show that this need not be. Good and persistent service and scientific treatment of lighting are necessary to maintain the business; and a campaign is wanted to convince the "man in the street" as to certain errors of belief. But truth to tell, little appears to be doing in this respect. Apart from industrial power, lighting is the main business for many electricity undertakings; it is practically the only business for a great number. Consequently, what do we find? That in the daily and weekly papers, the householder and the factory owner is being constantly confronted by electric-lamp advertisements; while the gas industry appears to be largely concentrating on heating and hot-water supply. The logic of the position suggests that the point at which competition hits the hardest—we freely admit it—is the point at which the gas industry along general lines, and gas undertakings locally, should make the strongest and most energetic attack and defence, while not neglecting other business. This seems to us the common sense of the situation.

In the competitive work, another thing that is wanted is greater collaboration between the gas sales officials of gas undertakings and the contractors for gas-lighting burners, lamps, and systems. Enough is not done in this way. It cannot be expected that all gas salesmen are such experts in lighting matters that every and any condition of lighting requirement that comes before them can be prescribed for by them off-hand. With the contractors, the whole country is their field; and their experience of needs, in all sorts and conditions of circumstances, constitutes them specialists of the first degree, and their experience should be of considerable value to the gas industry, if only full advantage is taken of it. It is the height of folly not to utilize in the greatest possible measure the experience that is available, if only it is sought and made welcome. Only by way of example, take high-pressure lighting. A large business is done in this by the contractors apart from gas undertakings—particularly in the lighting of factories. This comes to mind because, only recently, there was brought to notice a new and important factory in a London suburb where the consulting engineer or architect had advised the installation of electric lighting. Architects are rarely experts in artificial lighting. They know little or nothing about the merits of the two competing lights. The concentrated brilliance of electric gasfilled lamps dazzles them. The effect upon the eyesight does not trouble them, because they have no information regarding it; and the fact that glass screens and reflectors are costly adjuncts does not disturb them, because the clients have to pay for them. The eyesight of the workers in factories is no concern of theirs. The large percentage of short lives of such lamps is beyond their knowledge, and so maintenance and renewal become also only an affair for the factory owner. The fact that a steady light can be obtained the gas way, of lower intrinsic brilliancy, and of excellent purity in regard to composition of light, and at a low cost, are advantages of which they are more or less ignorant. However, in the case in mind the decision of the consulting engineer to the factory in question was reversed, as the result of co-operation between the representative of the local gas company and a firm of contractors for high-pressure lighting. The combination of knowledge had a fruitful result in this instance; and so it might in others. The hint will no doubt be taken elsewhere.

It is with the high-power gasfilled lamps—at one time misnamed the "half-watt"—that gas undertakings have in these days to carry on the contest, particularly for street, factory, and shop lighting. It depends largely on how the competition is conducted whether or not the gasfilled lamp succeeds, particularly in the higher units. There is no question that in factories, and for shop lighting and street purposes, the most effective competitor of these gasfilled lamps is high-pressure gas lighting, whether the units be of 60 c.p. or any intermediate value up to 1500 c.p. Of course, there are places where high-pressure lighting cannot be installed. It has fields where it is highly applicable; but the situations are countless where the low-pressure lamp "fills the bill" admirably. We have lately been in various parts of the South Metropolitan Gas Company's area; and it is notable how, with the keenness of competition there as elsewhere for shop lighting, the Keith high-pressure type of lamps has, since the war, been brought back to the duty of lighting the windows of many business establishments. Inquiry assures us that the number of such lamps has returned to approximately that which obtained before the war. Why is this? Because the Company has been persistent in (as was gathered from Mr. M'Leod's letter last week) operating in the direction in which competition is the keenest, while not neglecting the quarters from which new successes come more easily. This is unquestionably the correct policy. The proof is found in the fact that in the shopping area of the South Metropolitan Company lighting business is being secured; and in this respect compared with any other district of which we know, with the possible exception of Halifax, the Company are much ahead of any other. The case of the competitor is no doubt plausible enough till the figures are examined, and the evidence of the other side is put forward. Then, the new complexion placed on the matter raises the interest of the factory owner or tradesman, and as in the cases of the factory previously instanced and the South London shops, so in many others, gas can and does secure the verdict.

There is a point regarding high-pressure gas lighting that should be made. The argument is often put forward that the compressor means some additional expense in contrast with low-pressure lighting. Of course, it does; but the extra expense is negligible compared with the necessity of putting forward the best efficiency known in connection with gas lighting. The extra duty obtainable from the gas is an offset to the compressor; the prestige of the industry, and the defence of the gas-lighting load, are surely worth something.

Those gas undertakings that are obsessed by the view that it is no use troubling about the lighting business are making a grievous mistake. As a matter of fact, electrical people, with the electric lamps of higher efficiency that they now have (which mean a smaller consumption of current per point) are veering round to the opinion that the small householder only brings to the undertaking another loss, and the aggregate of losses represents a very substantial sum. They are consequently doing all possible to secure those consumers who return a profit on their consumption. It is these consumers over whom the best efforts should be made by gas undertakings to retain or secure their custom. But let this be marked: The more consumers are allowed through the negligence of gas undertakings to become possessed of the idea that the superior light is provided by electricity, the greater will the idea spread; the more that is done to disabuse their minds of the erroneous notion, the more lighting business will the gas industry obtain and retain, as has been shown by the Croydon and the South Metropolitan Gas Companies. Quality of light, reliability, and actual lighting performance, with cost economy, are on the side of gas. The old order of procedure, of letting lighting take care of itself, must end. There should be in regard to it a new and a ceaseless activity; and a great deal more spirit and knowledge must be displayed. If not, then where lethargy and unwisdom prevail, there the cream of the lighting must go to the other side. And the pity of it will be that there exists no real reason for the change.

The Board of Trade and "Basic" Prices.

There can be no further controversy as to whether the Board of Trade can and will deal with applications to them for the South Metropolitan profits division plan. We have contended all along that they can do so under section 10; and authority was given us by the Board to say this some months since. Mr. Clode, K.C.,

as representing the Cardiff and the Swansea Gas Companies before Sir Harry Samuel's Committee in the House of Commons, took a contrary view. But on the Swansea Company's Bill last week, the matter was definitely settled. The point was again discussed; and then the Chairman took the very proper course of deciding to confer on the matter with representatives of the Board of Trade. The result of the conference was that he announced that the Committee had resolved to put a clause in the Bill leaving the fixing of the basic price to the Board. He stated that he was sure they were doing the best for all parties concerned. The whole thing was very complicated, and would be most difficult, especially having regard to the very rapid changes that were taking place. Thus those gas undertakings that propose to adopt the South Metropolitan plan of profits division will note the two points: (1) That the Board of Trade can deal with the matter; and (2) that a Committee of the House of Commons consider it better they should do so. The Board have all the machinery and authority necessary for the purpose. The decision bears-out what was said in an editorial article on the subject last week.

"Declared" or "Supplied" Calorific Value.

From a letter in our "Correspondence" columns to-day, it is learned that Mr. H. E. Ibbs, now that he has freed himself from the compilation of "Field's Analysis for 1920," is considering the form the famous work should take when he comes to deal with the figures on the therm basis. He is inclined to take the supplied calorific value rather than the declared; but he would like to know what other gas men think. The question should be discussed now, so that a basis may be adopted that is generally acceptable. Mr. Ibbs will therefore like to have criticism and suggestion regarding the points he submits in his letter.

Gas Oil Price Reduction.

The prices of oil and spirit of various descriptions have been moving-down lately. There was a substantial drop in the price of gas oil at the end of last week; the market quotation being *ex*-wharf 7d. per gallon. This will be a satisfaction to those makers of water gas who are producing large percentages, and at the same time are "stretching" their coal gas, and so require a gallon or so of oil per 1000 c.ft. for enriching purposes, and to help to keep things in good condition in the distribution system and consumers' meters. There is still a good margin between the pre-war and the current price of gas oil.

The C.O. and Inerts Inquiries.

It is hoped that now the final meetings of the Inerts and Carbon Monoxide Committees have been held, and that the next thing will be the reports and recommendations. With regard to these, the President of the Institution (Mr. Thomas Goulden, M.Inst.C.E.), in the address published elsewhere to-day, says: "I do not anticipate that, with respect to either carbon monoxide or incombustible constituents, the freedom which has been given us by the provisions of the Gas Regulation Act as a whole, will, by the exercise of any of its parts, be injuriously affected. It is of the utmost importance that every avenue should be left open to the industry to conduct gas manufacture in the most scientific manner possible, so that the highest economy in the consumption of coal may be attained." We of the gas industry all endorse the President's hope and anticipation. The Inerts Committee met to hear evidence (and it appears probable they will not seek for more) on Wednesday of last week, when they had before them Mr. George Helps and Prof. R. V. Wheeler, of the Sheffield University, the results of the work of the latter of whom (especially with regard to carbon monoxide) has been the subject of publication and reference on various occasions in our columns. Mr. Helps went before the Committee armed with ample documentary evidence and tabulated statements, setting out completely and particularly the grounds on which he advocates the supply of low calorific value gas, and unrestricted freedom in respect of inerts. These grounds are well known to our readers; but nevertheless we are publishing what Mr. Helps put before the Committee, as this constitutes the latest presentation of his case.

The Coal Strike Climax.

The position in the coal strike became worse, instead of better as was hoped, last week. One thing has been made clear. It is that the Executive of the Miners' Federation have been merely the puppets of the District Councils, which are packed by extremists, who will not, unless something compels, take a ballot of the men themselves upon the Government or any other offer. They rejected the Government proposals to which reference was made in the editorial columns last week; and this without any thorough test being applied to ascertain the opinion of the men themselves. This is not democratic government; it is simply dictation by the few—dictation to the miners, and dictation to the Government and the country. But if the rank-and-file of the miners are willing to accept this position of being slaves to these men, neither the Government nor the country is prepared to be so. The extremists will not follow the ordinary method of submitting matters in dispute to arbitration; they desire to be sole arbiters and absolute dictators. The Executive of the Federation have had to take the part of the impotent, and to inform the Government that their proposals must be rejected, because the districts—meaning the local Councils, and not the miners in the aggregate—will have nothing but national regulation, and are still solid for the pool. But they do not say how the "pool" is going to bring back the coal trade to the country.

A Firm Stand.

The Government have now taken a firm stand. They have thrown on the Miners' Federation the onus of finding a way out. In a letter, dated the 4th inst., the Premier stated that the Government had come to the conclusion that the offer of the subsidy of £10,000,000 could only continue for another fortnight, which will give sufficient time to take a ballot of the miners, or to reach a settlement in some other way. The country cannot afford to let this offer go on longer, seeing that the strike is costing its millions of pounds every week it continues. The coalowners, recognizing that the loss of the subsidy would be a serious matter, wrote to Mr. Hodges suggesting a conference to attempt once more to settle matters; and they are again conferring—now without Government intervention. There is no doubt the other trade unions of the country are getting sick of the rejection by the Miners' Federation of everything offered to them, and of their refusal to discuss proposals in any way whatever if they do not exactly square with the demands of the Executive. The National Union of Railwaymen and the Transport Workers' Federation have completely withdrawn the embargo on imported coal, in view of the fact that a large proportion of their members would have nothing whatever to do with it. The stoppage of coal output has now continued for about nine weeks; and the loss is between 36 and 40 million tons, even taking the low average of 4 million tons a week. The output during some weeks in December was upwards of 5 million tons.

Reclaiming Old Gas-Mains.—A 10-in. wrought-iron gas-main originally laid in the United States for natural gas, and dug-up after lying buried for 26 years for replacement by a high-pressure main to carry artificial gas, was found to be in good condition, excepting where the screwed joints had been weakened by corrosion. As the pipe was of the same diameter as was required for the new main, it was decided to reclaim the sound portions and use them as far as possible in reconstructing the line. The process consisted merely of cutting-away the old screwed joints with an oxy-acetylene torch, and butt-welding the salvaged sections. The main was then found adequate in every way for carrying the working pressure required. The saving resulting from this course was of no small importance. As the cost of jointing the sections was practically the same as would have been involved in making the connections with new pipe, the entire cost of new material was saved; the only extra outlay being that involved in cutting-away the old corroded joints.

Limits of Natural Gas Supply.—It has, says Prof. R. H. Fernald (head of the Department of Mechanical Engineering in the University of Pennsylvania), been estimated that two decades will see the total exhaustion of the natural gas supply of the United States. This rapid exhaustion is coming about through "criminal negligence and reckless extravagance;" and it is imperative that full investigations be at once taken in hand, to determine the most practical solution of the industrial problems that have been for many years past so vitally dependent upon the natural gas supply. In the light of the limited amount of study that has so far been given to the matter, the most conspicuous form of relief seems to be through the development of bye-product producer gas—at present practically an unknown field in the United States. Prof. Fernald thinks investigation may show a combination of low-temperature distillation and the manufacture of bye-product producer gas to be a distinctly economical and commercial solution, as these processes, on the one hand, lead to the maximum bye-product recovery, and, on the other, to a supply of gas commercially adaptable to heating and general industrial processes.

THE INSTITUTION OF GAS ENGINEERS.

ANNUAL MEETING, 1921.

ADDRESS BY THE PRESIDENT,

THOMAS GOULDEN, Esq., M.Inst.C.E.,

Chief Engineer to the Gas Light and Coke Company.

Following the normal course of events, it would have been my duty and pleasure, at the end of the twelve months during which I have had the honour of occupying the Presidential chair of the Institution of Gas Engineers, to deliver verbally my valedictory Address to the assembled members. It is a matter of sincere regret to me that the arrangements made for our annual meeting have had to be postponed, in consequence of the disabilities attaching to absence from works while the unfortunate dispute in the coal mining industry and transport services still continues.

In order that members of the Institution should have prompt information which it is considered inexpedient to withhold for the deferred meeting, it has been decided to publish for the information of members certain of the reports that would have been submitted to the general meeting—among them the fifth and sixth reports of the Gas Investigation Committee and the paper by Sir George Beilby, F.R.S., on "Steaming in Vertical Gas-Retorts," which is in itself a valuable report.

Similarly departing from precedent, for which the present industrial position must be my apology, I have to present my address to the members of the Institution by the courtesy of the "Technical Press."

Gas Regulation Act, 1920.

At this important period in the history of our industry, our thoughts naturally revert to the meeting we held a year ago, when my distinguished predecessor, Sir Dugald Clerk, K.B.E., addressed you on subjects current at that time. It was a period of more than ordinary anxiety to us; for, although we were looking forward confidently to a measure to be promoted by the Board of Trade that was to bring to the undertakings we serve relief from their very serious financial troubles arising out of the war and its aftermath, neither the extent to which we might anticipate relief, nor when we might expect it, was in any way definite, while rumours of restrictions by which the expected Bill might be accompanied as conditional to its acceptance, were apt to weigh somewhat heavily on our souls.

Our doubts are now dissipated by the enactment of the Bill which was subsequently promoted as a Government measure by the Board of Trade; and the "Gas Regulation Act, 1920," is an accomplished fact. The Act is of extreme importance to our industry and to the public—not only by reason of its financial provisions, that have been so anxiously awaited, but from the provisions relating to the revolutionary change in the basis of the sale of gas, and the all-important fact that gas undertakings will, in the future, themselves determine the calorific power of the gas they intend to supply. The latter provisions are destined to effect a complete revolution in the conditions under which the manufacture and supply of gas have hitherto been conducted, and that in a considerably shorter space of time than would have been possible by any other means than an Act such as this, so general in its application and of so sweeping a character. Section 1 of the Act, sub-section 5, gives the Board of Trade powers, in default of an undertaking not having within two years after the passing of the Act applied for an Order, themselves to make an Order on such undertaking after three months' notice has been given. In two years from the present time, therefore, the Act will have been applied generally throughout the United Kingdom.

That the passing of the Bill, so revolutionary in character and of such vital importance to the industry, was successfully accomplished in its present form in a single session of Parliament, is an event upon which the officials of the National Gas Council are to be heartily congratulated. I am sure it will be the desire of every member of the Institution of Gas Engineers that we should acknowledge the deep indebtedness of the gas industry to the Executive of the National Gas Council, and especially to their President, Mr. D. Milne Watson, for the energy, tact, and skilful persistence with which the case of the industry was presented, and the passing of the Bill conducted to its final enactment in the form in which the Act now stands.

The financial relief which gas undertakings will derive from the possession of the Act is, indeed, sadly needed; for although dividends were prevented from fading-away to actual vanishing point by the "Temporary Increase of Charges Act, 1918," it had for some time past been obvious that in default of some such statutory measure as that which has been enacted for improving the miserable financial position to which gas undertakings had been brought by the increased cost of gas production and supply—due to war and post-war conditions—the industry generally must have speedily lapsed into a state of utter bankruptcy, to the very serious detriment of the work carried on by one of the most essential of the public utility services of the country.

To difficulties in working arising from the embarrassed condition of the undertakings themselves was added the impoverishment of the unfortunate shareholders in private undertakings. The extent to which some of the smaller shareholders, dependent for their income entirely on limited investments in gas stock, suffered, can only be realized by a perusal of the pathetic accounts given in letters received from them, of their deprivations arising out of the simultaneous reduction of their dividends, and the increasing cost of living. This appears to me to have been one of the greatest ironies of the war, in view of the extreme importance to the country of the services rendered by the gas industry, which were so essential that I do not hesitate to state that had our industry, which within my easy recollection was referred to in a Committee of the House of Commons as a "decaying industry," proceeded downwards to the end of the road thus direfully prognosticated as the direction in which it was travelling, it would have to be recalled and reconstituted—if only for the purpose of supplying the raw material for those munitions of war, vital to the successful prosecution of hostilities, which we brought forth so abundantly during that prolonged period of crisis.

The late Lord Moulton—alas! that we should thus have to write of him—bore eloquent testimony to the real value of what he termed "our peaceful industry, playing so great a part in the shaping of our daily lives," during the war. It is fitting that we should pay our tribute to the most eminent of our Presidents, in the person of this gifted and earnest man, of whom truly it may be said that he was not the least of "Leaders of the people by their counsels, and by their knowledge of learning meet for the people, wise and eloquent in their instructions, honoured in their generation, leaving a name behind them, that their praises might be reported." John Fletcher Moulton has passed beyond the veil, to the profound regret of all who had the privilege of being associated with him, leaving behind a lasting memory of good work for the state, of friendship that was mutually enjoyed, and the inspiration of something of his own indomitable spirit, which moved him at the age of "three score years and ten" to accept the all-important office of Director-General of Explosive Supplies, the work of which department proved so brilliantly successful under his leadership. Especially grateful to us will remain the remembrance of his generous acknowledgments of the assistance that we were only too glad to have been able to give him in the successful carrying-out of his last and probably greatest and most vitally patriotic task.

The hypothetical reconstitution of gas, however, fortunately for the country, was not necessary. On the contrary, although our industry is well past its century in point of age, I see no sign of its vigour being abated. I recollect no time when more practical work was being done,

or so much earnest and skilled research conducted, both in the production of the commodity we manufacture, and in the manner of its application to the use of the consumer.

The effect of the new Act will be considerably to accentuate the working-out of the many problems calling for solution in our endeavours to attain that which is the main purpose of our industry—viz., the supply of the consumer with potential heat units in the form of gaseous fuel, of a composition best suited to his needs, at the lowest possible price. That the field open to us is of the most extended character, may be judged from the facts that the consumer of domestic coal even yet contaminates the atmosphere of this country with the smoke arising from the consumption of no less a quantity than 40½ million tons of coal annually, and that there is in factories a further annual consumption of 60 million tons of raw coal.

GROWTH OF THE INDUSTRY.

The increasing extent to which gas is appreciated by the public may be realized by a comparison of the statistics of gas consumption and the number of consumers for the years 1909 and 1919, extracted from the Board of Trade returns relating to authorized gas undertakings in the United Kingdom. From these we find that, as between the two years named, the annual consumption of gas increased from 177,687 million to 228,538 million cubic feet, an increase equal to 28·6 p.ct.; while the increase in the number of consumers was from 6,164,066 to 7,540,133—an increase of 22·3 p.ct.

The total amount of capital employed in the gas undertakings of the United Kingdom paid and borrowed now amounts to £150,000,000. In the case of the undertaking with which I am more closely concerned (the Gas Light and Coke Company), the consumption of gas in the district has risen from 24,743 millions during 1909 to 31,964 million cubic feet during 1920—an increase of 29·3 p.ct.; while the number of consumers has increased from 670,925 in 1909 to 843,128 in 1920, equal to 25·7 p.ct. increase. The Company's automatic consumers increased during the same period by 33·3 p.ct.—from 387,169 to 516,092. It is significant of the extended use of gas made by the latter class of consumer that as between the two years named the annual consumption per consumer increased from 12,895 to 20,953 c.ft.

We may fairly claim these statistics as being conclusive evidence of healthy progression, which I am of opinion is likely at least to be maintained, and probably considerably surpassed, in the future. The quickening of the public conscience with regard to the many evils resulting from the smoke nuisance arising from the burning of raw coal, the increased cost of coal, the cleanliness and saving of labour due to the substitution of gas for coal for domestic purposes, all tend strongly to the increasing adoption of gas in the home for purposes of cooking, heating, and lighting; while the facility of manipulation and the ease with which temperatures can be adjusted are rapidly increasing the favour with which its use is regarded for many industrial purposes.

THERMAL VALUE OF GAS.

The alteration in the method of charge—by therm, in substitution of per 1000 c.ft.—will also, I believe, tend to popularize the extended use of gas, as the meaning of the therm becomes better understood, and the public realize that they are being charged solely on the basis of the utilizable property of the gas they consume.

There can be little doubt, in view of the fact that the general use of gas is now in respect of its potential heat value, that the therm has become the only logical basis of sale, and that the time is fully ripe for its general adoption in making out the charge for gas. It is strange indeed that the sale of gas on this basis has not been effected sooner. That sooner or later gas would be utilized solely in respect of its heat potential was obvious to all who realized the possibilities that eventuated from the introduction of the incandescent burner of Auer von Welsbach, who was awarded the Institution's Birmingham Gold Medal in 1897. It has always appeared to me that the first gas engineer in this country to realize what was afterwards to result in this direction was the late Sir George Livesey, the first recipient of the Birmingham Medal, in 1882, whose commonsense leadership of our industry through a long period of eventful years will ever remain with us in affectionate remembrance. Sir George Livesey, in promoting the South Metropolitan Gas Bill of 1900, having as its purpose the reduction of the standard of illuminating power of the South Metropolitan Gas Company from 16 to 14 candles, recognized the waste which, even at that time, attached to the unnecessarily high candle-power then in vogue in the Metropolitan area. This could not be obtained economically in the gas produced from common coal without added enrichment, usually in the form either of highly carburetted water gas or the addition to the coal gas of the vapour of benzole or similar enriching spirit. Among the evidence submitted to the Committee adjudicating upon the Bill was the famous "Dessau" diagram, which demonstrated that the luminous effect of the Auer burner actually increased as the gas consumed (stripped of its hydrocarbons by extraction with oil) was reduced from about 15½ candles to the point of non-luminosity. Sir George gained his Act; and the first step was taken towards the position at which we have at last arrived.

Mr. Harry Jones, in his Presidential Address to our Institution in 1904, characteristically expressed his views as to the path of progress for the industry—"Fuel must be our flag," and "every household, every small trader, every user of power, will hail our advance." The years passed on, during which the incandescent burner was coming into general adoption as the agency of procuring artificial light by means of gas; and meanwhile the use of gas for cooking and heating, as well as for industrial purposes, was increasing by leaps and bounds, until we find the late Sir Corbet Woodall, when President of the Institution in 1913, expressing his opinion that: "The time has fully arrived when a definite change should be made in the standard by which the value of gas is determined. When nearly the whole of the gas sold is used for purposes where the luminosity of the flame is of negligible importance, it is clear that a test which only determines that element is an obsolete one. As the consumer is interested only in the heating value of what is supplied to him, it is heating value that should be determined by the test." Sir Corbet, with the courage of his convictions, added practice to precept during the following year (1914), when the Gas Light and Coke Company's Bill for the abolition of the illuminating power standard of that Company, and for the substitution thereof by a calorific standard, was promoted by him. The enactment of this Bill originated the sale of gas by virtue of its calorific power in the Metropolitan area, and incidentally, by the abolition of its illuminating power standard, enabled the Gas Light and Coke Company, immediately upon the outbreak of hostilities in August, 1914, to commence the extraction, by oil washing, of crude spirit from gas for use in the manufacture of high explosives.

CALORIFIC STANDARD.

What calorific standard to adopt now must be seriously exercising the minds of the technical advisers whose responsibility it is to make recommendations to the administration of gas undertakings.

In Sir Robert Hadfield's Address, as President of the British Commercial Gas Association in 1918, he quoted Sir Arthur Duckham as being sensible "of the extreme importance of the establishment of a uniform standard for gas supply throughout the country," at the same time suggesting a uniform calorific value of between 450 and 500 B.Th.U. net per cubic foot of gas. The importance, not only to gas undertakings, but also to the country at large, of the introduction without delay of a universal standard for gas was also impressed upon us by Lord Moulton in his Presidential Address to us in the same year; but no actual figure of standard calorific value was suggested.

The subject of standard calorific value has also been studied in the United States of America; and in a report made to the Board of Gas and Electric Light Commissioners, Commonwealth of Massachusetts, 1917, following on investigations specially made with relation to establishing a calorific standard for gas, a "minimum standard of not over 525 total British thermal units" was recommended, with the reservation that "this figure might need revision in the early future." This, in such a quarter, was a striking revulsion of opinion upon the general question of gas supply.

There can be little doubt of the many advantages derivable from the existence of a uniform standard of gas supply. The standardization of appliances throughout the country which would be possible would be of enormous benefit, both to the consumers and to gas undertakings, by reason of the absence of the need for the frequent adjustments that are now necessary. To standardize appliances,

however, would not only presuppose standard calorific value, but also a standard composition of gas, involving the unification of methods of production. Desirable as this may be, I fear that the near future is likely to bring with it greater, and not less, diversity of method. I agree entirely with the expressed views of the two eminent authorities I have quoted in their opinion as to the importance of, at any rate, some approximation to uniformity of calorific standards, as a long step in the right direction, although I disagree as to the range of calorific value suggested.

A range of calorific value between 450 and 500 B.Th.U. net, which corresponds to 500 to 560 units gross, permits of too little flexibility in methods of manufacture to be acceptable. The lower figure of calorific value is that of a mixture of straight coal gas and blue water gas containing not more than 15 p.ct. of the latter, while the higher figure predicates straight coal gas only, of a high quality. My principal objection to either one or the other is that neither permits of that economy in the use of coal, of which the importance is now universally recognized. Assume for instance the production of a gas of 500 net calorific value, which as I have observed is equal to 560 gross calorific value—necessarily a straight coal gas. It would be indicative of excellent retort-house practice that 70 therms should be obtained per ton of coal carbonized—an amount approximating to 24 p.ct. of the thermal content of the raw material, representing as nearly as may be 48 p.ct. thermal efficiency in gaseous production. The production of therms may, however, be considerably increased, with consequent saving of coal, if we content ourselves with a lower calorific standard—say, 475 B.Th.U. gross—obtainable by admixture with the coal gas of water gas to the extent of one-third of the total. We should, it is true, diminish our net production of coke by from 2 to 2½ cwt., dependent upon whether or not we use waste-heat boilers; but for the destruction of one ton of coal we should have obtained 88¾ therms in the form of gaseous fuel. The latter quantity, produced from coal alone, would involve the destruction of 1·27 tons. The thermal efficiency of gaseous production would have been increased from 48 to 52 p.ct.

As a practical example of the saving of coal induced by the manufacture of a limited proportion of water gas, I give a few statistics of the working of the Gas Light and Coke Company during the past year, 1920. The total gas made was equal to 35,148,709 thousand c.ft., of which 20·9 p.ct. was water gas, mostly lightly carburetted. The coke used in the manufacture of the latter was 147,700 tons. Had no water gas been made, the consumption of coal for the year, 2,279,250 tons, would have needed to be supplemented by no less a quantity than 415,750 tons, a quantity which was saved to the country by the manufacture of water gas, at the expense of 355,000 tons of coke, representing that which would have been residual from the additional coal, *plus* that consumed in water-gas manufacture. The potential addition of this quantity of coke to an overburdened market is also a point for consideration. The average calorific value of the gas was 485 B.Th.U. gross.

[Since the above remarks were written, the deplorable dispute in the mining industry has taken place and has resulted in the complete cessation of supplies of coal from home sources, while simultaneously union action has used every effort to prevent our wasted stocks being supplemented from outside the country. The situation has called for extreme economy in the conversion of coal into gas; and except for water-gas manufacture, and the consequent gasification of coke, many undertakings must inevitably have been unable to carry on. The extent to which the use of water gas has permitted of economy in coal consumption may be judged from the fact that according to the weekly returns of working I have before me, one of the stations of the Gas Light and Coke Company, making 48½ p.ct. of water gas and using 1·1 gallons of oil per 1000 c.ft. of water gas made, has distributed no less than 111 therms per ton of coal carbonized.]

For my own part, although I have referred to a calorific standard of 500 B.Th.U. gross as being higher than is generally desirable, I consider it wise to proceed very carefully in the lowering of the general standard of calorific value, especially as this is usually accompanied by an increase of specific gravity in the lower grades of gas. I have records of testing in my possession showing that the specific gravity of a gas of 350 B.Th.U. calorific value is as high as 0·715. In the case of the Gas Light and Coke Company, the gas produced at the Beckton Works is pumped through two trunk mains, each of 4 ft. diameter, to its initial point of transference to the district mains. The maximum initial pressure in these mains is already equal to 54 in. head of water. Were the gas manufactured during 1920 replaced by gas of 350 calorific value, 38½ p.ct. more would need to be pumped for an equal delivery of thermal units, with the consequence that either the pressure of pumping would have to be increased nearly three-fold, or a third main laid in order to accommodate the larger volume of gas. Pumping plant would need to be correspondingly increased—in either case adding rather more than a penny to the cost per 5 therms delivered to the initial point of distribution, 3½ miles away from the works. Within the works the increase of volume would have to be reckoned with, giving rise to the necessity for extensions of mains and purifying plant, station meters and gasholders, involving enormous outlay chargeable to revenue, thus increasing the cost of gas, already at too high a level. Besides this, we already find that, in spite of relatively high pressure in the district mains, the carcase pipes in the houses of consumers are, to put it at the best, no more than adequate to the supplies needed, and any serious lessening of calorific value would immediately result in a call for the extensive re-carcassing of houses and the replacement of the existing meters by others of greater capacity, in order to deal with the larger volume of gas needed to supply equivalent thermal units.

Altogether, I consider the disadvantages belonging to the curtailment of calorific value in the case of the Gas Light and Coke Company as being manifest, and the declaration of a standard of 475 B.Th.U., which means the production of a 485 B.Th.U. gas, is undoubtedly the right course to have decided upon. I am not so conversant with the position of gas undertakings other than my own in respect of the various points to which I have just referred; but, judging from the general protest put forward when the subject of increased pressure was recently considered, I am strongly of opinion that any material lowering of the standard of calorific value requires very careful consideration. The correct policy must surely be to maintain calorific value at the highest at which the therm can most cheaply be produced and distributed. Our distributing systems are for the purpose of conveying gaseous fuel to our consumers, and the value and expense of operating distributing plant are wasted to the extent that we employ it for the transportation of either gas of unduly low calorific value, or of inerts in excess of the proportion present after the exercise of reasonable care in manufacture. Whatever may be the argument as to high "inerts" not being prejudicial to general efficiency in the use of gas, they can in no wise improve it; and the fact that when they are present in excess the domestic consumer takes a longer time to boil water in a kettle makes all the difference in the world to her opinion of the merits or demerits of the gas with which she is supplied.

The standard of calorific value which I personally prefer to adopt under existing conditions is 475 B.Th.U. gross value, as representing one that is capable of meeting all the needs of the general consumer of gas, and one that can be economically manufactured and distributed. This calorific value is at the same time low enough to enable manufacture to be conducted with very considerable diversity of method. Where there is ample gas-main distributing power to meet the problem of distribution, the range of calorific value for adoption as standard may be lowered to (say) 425 B.Th.U. gross value, permitting the gasification of a very considerable proportion of coke for supplementing the gas otherwise produced, when this method of procedure is considered desirable. Experience alone will show us whether any further lessening of the lower value I have indicated as a minimum standard calorific power may be advantageously entered upon.

GAS RESEARCH WORK.

On the subject of calorific value, as on other important factors connected with the manufacture and application of gas, I cannot but express my sense of the debt we owe to those gentlemen, who, under the auspices of our Gas Investigation Committee, have already added, and are continually adding, so much to our useful knowledge of the scientific manufacture and application of gas. To our appreciation of the work done by the Leeds University staff, I would add that of the valuable researches made by the Fuel Research Board, under the directorship of Sir George Beilby, from whom we are glad to welcome an important contribution to

our proceedings in his Paper on "Steaming in Vertical Gas-Retorts."

The effect of the Gas Regulation Act tends to throw the whole manufacture of gas into the melting pot; and it is by the information placed at our disposal by the researches of purely scientific Committees such as the one I have mentioned, that the ultimate course and method of our work must, in a large degree, be guided. The Fuel Research Board of H.M. Department of Scientific and Industrial Research have their own experimental station in which to conduct researches; but in the case of the gas industry, we must, in default of a similar experimental station—which I fear is not practicable, although so very desirable—open our doors to the fullest extent, for the purpose of providing the experts of the Gas Investigation Committees with those facilities which alone enable the all-important work of research to be effectively carried on. Investigations into the working of vertical retorts have already been made at Uddingston; and the Fourth Report of the Gas Investigation Committee, presented last year, shows the valuable nature of the work done. There still remains, however, an extended field for further investigation into such subjects as the use of gas in high-temperature industrial processes, total gasification, the internal carbonization of coal, burners, and other kindred subjects, with regard to which precise details, obtained by careful scientifically trained experts, will be welcomed as additional signposts pointing our road to progress in domains which need exploration. Sir Dugald Clerk, in the "James Forrest" lecture that he delivered last year to the Institution of Civil Engineers, prophesied that "in a few years the majority of gas-works will deliver to the consumer, for domestic purposes, in the form of gas, 75 p.ct. of the whole heat of the coal, used at an average efficiency of 55 p.ct.

The figures of efficiency thus foreshadowed, especially that regarding the thermal efficiency of production, are much in front of present-day practice. They constitute a high ideal to aim at, which will need all the energy and the knowledge arising out of carefully applied technical training.

Board of Trade Inquiries into Carbon Monoxide and Inerts.

At the time of my writing this address, the two subjects of "carbon monoxide content" and "incombustible constituents" are under consideration by the respective Committees appointed by the Board of Trade under the Gas Regulation Act to inquire into and report as to whether limitation is desirable, and, if so, to what extent? With regard to the former, carbon monoxide, I believe we are agreed that no limitation is either necessary or desirable. I have had long experience of the manufacture of carburetted water gas—having erected and personally operated the first plant put to work in this country; and my experience is confirmatory in every way of the absence of necessity for limitation, from the view of either the protection of the public or the safety of the workmen engaged in water-gas manufacture.

The large extent to which carburetted water gas still continues to be used for public supply in the United States of America amply confirms this view; and to-day (among many other important cities) Washington, the Capital, is supplied with 100 p.ct. carburetted water gas. I am sure I need say no more on this point, except possibly to refer to paragraph 2 of the "Water Gas (Emergency) Order, 1921," May 4, 1921, made by the Board of Trade under Emergency Regulations (No. 2) 1921: "No coal shall be utilized for the manufacture of coal gas in any such undertaking as aforesaid, and no coal gas shall be supplied from any such undertaking, unless and until the permissible requirements of consumers of the undertaking shall first have been met to the fullest possible extent by the manufacture and supply of water gas as in the last-preceding clause provided." This paragraph is particularly interesting as clearly ordering that if any undertaking can supply the demands of its consumers with 100 p.ct. water gas, it is to do so before utilizing coal for the purpose of manufacture and supply. It is to be hoped that any such undertaking is well supplied with coke before commencing to carry out this instruction. As regards the value of water gas mixed with coal gas, the higher thermal intensity of its flame, due to the consequent larger proportion of carbon monoxide content, considerably enhances the brilliancy of the incandescent mantle, and also adds to the value of the gas for industrial applications requiring high temperatures.

In a series of experiments in melting copper recently made at my direction, the smaller number of heat units required per pound of metal melted is incontestible proof that gas of comparatively low calorific power, containing a larger percentage of carbon monoxide, is superior to a straight coal gas of high calorific value containing a minimum of carbon monoxide content and comparatively low inert constituents. Any undue limitation of carbon monoxide would deprive us of flexibility in methods of manufacture, would be wasteful in the consumption of coal by limiting the extent to which coke may be employed for conversion into gas, and would seriously hinder the progress of the total gasification of coal. It would be retrogressive, and would, without corresponding benefit, go a considerable direction in nullifying one of the principal purposes of the Gas Regulation Act.

Incombustible Constituents.

With regard to incombustible constituents, while I am of opinion that no greater proportion should be permitted in the gas than that which is necessary to economical production, it appears to me that limitation by statute is also unnecessary. Ample evidence, with which all must be familiar, has been put before the Committee to justify this position; and it appears that control with regard to this detail is sufficiently ensured, not only by the system of charge by therms, but by the recognized fact that the cost of distributing more than the economic minimum of "inerts," is so much waste that must quickly react to the disadvantage of the business of the undertaking that follows so undesirable a practice.

The reports of the Gas Investigation Committee prove that up to quite considerable proportions of "inerts," the ordinary consumer suffers little prejudice; so that in this detail the matter of inerts—up to (say) about 30 p.ct.—is one in which every undertaking must use its own judgment as to what, in its particular case, may be considered necessary or desirable. I do not anticipate that, with respect to either carbon monoxide or incombustible constituents, the freedom which has been given us by the provisions of the Gas Regulation Act as a whole, will, by the exercise of any of its parts, be injuriously affected. It is of the utmost importance that every avenue should be left open to the industry to conduct gas manufacture in the most scientific manner possible, so that the highest economy in the consumption of coal may be attained. The need for economy in the use of coal has been so brought home to us by those conversant with the subject, that it would be superfluous for me to dwell upon what has for some time past been generally accepted. I would only remark upon the present coal-mining dispute as emphatically indicating the necessity of economy in the greatest degree in the consumption of coal.

Coke as Boiler Fuel.

As having an intimate bearing upon this subject, I would again refer to the large amount of coal annually used for industrial purposes. Of this, a considerable quantity used in the firing of boilers could well be replaced by coke, with considerable advantage to the community by reason of the decreased smoke nuisance, as well as the saving of the valuable bye-products lost in the consumption of the raw coal. In the Metropolitan area and that of its immediately surrounding suburbs, excellent work in the displacement of coal by coke for use in the production of steam has been done since the London Coke Committee was formed in 1913; and from that date up to the present time, upwards of 500 sets of forced-draught furnaces for the use of coke have been fitted in the district included in the operations of the Committee. The exceptionally favourable conditions of the export market for coke, which temporarily followed the termination of the war, naturally caused the London Coke Committee to mark time for a while; but present conditions are again favourable to the substitution of coke in the place of coal for steam production. For a considerable time much difficulty was experienced in adapting coke to effective use on the automatic chain-grates usually installed in the furnaces of water-tube boilers. This has now been overcome by the "Sandwich" system of blending coal and coke, invented by Mr. E. W. L. Nicol, M.Inst.Mar.E., the Engineer to the London Coke Committee; and large quantities of breeze and coke are now used in this way. The British Commercial Gas Association are engaged in propaganda throughout the country with the object of making known this method of employing coke for factory purposes; and much good will

result both to the health of the community, and in coal conservation, from the success of their efforts. There are great possibilities in the direction of coal conservation foreshadowed by the successful use of inexpensive breeze and small coke for the production of steam at electricity generating stations. The undoubted advantages of electricity as a means of distributing and transmitting power are obvious; but equally well known is the large percentage loss of the original heat potential of the coal used in the raising of steam for the generation of electricity. It is a matter for serious consideration whether the whole question of coal conservation, so far as the future of electricity generation is concerned, should not be re-opened, with a view to ascertaining whether the economical production of both gas and electricity cannot better be secured by combination and co-operation rather than by continuing on the divergent lines hitherto followed. The product of our coal mines, which, as the Premier recently remarked, are "the most valuable property of the Nation," has far more than a mere fuel value, in that it is the source of so many commodities necessary to the well-being of the community. Its continued waste should no longer be tolerated when it is so essential that every item that may be transformed into an addition to the wealth of the Nation should be realized.

Labour.

Venturing greatly, I now give a few thoughts to the subject of our relations with Labour. It must be one of the great disappointments of the time that elimination of class feeling, which was to eventuate as not the least of the factors in the composition of the New World that was to arise out of the war, appears in the light of recent happenings in the labour world to be yet very far from becoming an accomplished fact. It was the knowledge that all were working and struggling to a common end, the intimate relations that existed between all ranks, the mutual trust of the rank and file in their officers, and of the officers in their men—in a word, the complete comradeship that existed—that made possible the final victory in the titanic conflict in which we and our allies were recently engaged. The industrial struggle of this country with its foreign rivals is of barely less importance in its ultimate consequences to the nation, since the penalty of permanent failure is that we shall cease to be able to maintain our population.

There can be little doubt that, in order to keep her place in the commerce of the world, this country is committed to a struggle of a severe order, likely to extend over an indefinite but lengthy period. How long a time will elapse before the commerce of the country finds itself again is impossible to predict, but it is certain that the time will surely be prolonged by such recurrent industrial disputes as have arisen during the post-war period with such distressing frequency, and which have now culminated in the coal-mining dispute, a disaster of the first magnitude to the country. That "a house divided against itself cannot stand" is as true to-day as when that axiom was first uttered, long centuries ago. Although our house of commercial supremacy has received a severe shaking from the industrial storms which are raging, its foundations are not yet destroyed. Means must be found to reconcile those interests, the activity of which exerted against, instead of in unison with, one another, are working such infinite harm to the community. All true citizens must grieve over these deplorable disputes, and that the settlement of reasonable relations between workers and employers should so frequently not be arrived at without a cessation of work, with all its evils, as precedent to agreement. Society has become far too complicated in its relative mechanism for the whole not to be affected in greater or less degree by the failure of one detail in its functions; and the duty of reconciling the various interests entering into the conduct of industry is all-important to the common welfare.

We need, it seems to me, closer human relations with our workpeople; better personal knowledge and more sympathy between labour and employers than usually exist. I do not suggest that economic laws should be set aside, but that the practice of economic laws in relations between workmen and employers should be tempered by humanity, if ever we are to arrive at industrial peace.

Co-Partnership.

Fortunately, we in the gas industry are able to show examples of considerable progress in this direction that may well be studied with the view to more extended application. The introduction of co-partnership into the gas industry, by the courage and foresight of Sir George Livesey, recognizing the psychological influence of an incentive to the interest of the worker in his occupation superior to that which could be expected from the mere receipt of wages, was epoch-making as a starting point on the road to industrial peace. How successfully this and other similar schemes, subsequently set on foot, have operated, is known to many of us by experience, and to all by repute. Co-partnership in the Gas Light and Coke Company was not commenced for several years subsequent to the inception of the South Metropolitan scheme; but I can testify by personal observation to the mutual benefit resulting from it, both to the employees and to the Company. The employees of the Company, I may remark, at the present time hold upwards of £300,000 of the Company's stock.

The basis of the calculation of the Gas Light and Coke Company's co-partnership bonus is, I believe, novel, in that the rate of bonus payable to co-partners corresponds with the rate of dividend payable to the shareholders in the Company's ordinary stock; the co-partner's capital being represented by his annual wage or salary. The earlier method of calculating the bonus, which that I have just described has superseded, had the defect that co-partners ceased to become entitled to bonus when the charge for gas rose above the standard price, despite their best endeavours by conscientious work to counteract the malign influences to which the increased charge was attributable. Under the scheme as it now stands, so long as the shareholder is entitled to a dividend, the co-partner is entitled to his dividend at a similar rate, thus maintaining his financial interest in the scheme when, except for the interest he might be entitled to for invested money, it would have ceased to exist. I cannot but look upon this as a distinct advance in connection with co-partnership, as assisting to preserve the interest of the co-partners during times of adversity. Moreover, it has this advantage from the educational point of view—that the employees better realize the moderate return for capital invested in the concern in which they are engaged.

One of the greatest advantages of co-partnership arises from the meetings and consequent discussions of the various representatives of employees of all ranks, with those charged with the administration of undertakings and their immediate representatives. The representatives of all grades learn to know one another, to appreciate the fact that mutual respect and good feeling can exist between all ranks, and, I believe, with few exceptions, are realizing that the common interest is best served in the practical recognition that all (if I may so express myself) are rowing in the same boat, in which it is nothing but folly for all members of the crew not to "pull together."

Works' Committees.

My experience of works' committees is equally happy. We have these at all the stations of the Gas Light and Coke Company. The representatives of the workmen in each works or in each department meet periodically with the superintending staff, to consider "domestic" matters—mostly connected with their respective stations, but in no way so limited, should it be considered desirable to deal with subjects of general interest. The meetings are in practice of a more or less informal character, in which the frankest expression of opinion is invited and is understood as being the rule. These committees are of the greatest value in the promotion of that feeling of fellowship which is so considerable an asset for harmonious working.

The systematic consideration of suggestions from workmen is also a matter to be encouraged. A mixed committee of workmen elected from their own body, and nominated officials of the Gas Light and Coke Company, meet periodically to consider suggestions for the improvement of appliances, methods of working, or generally with regard to the betterment of details either of manufacture or of distribution, and to recommend awards commensurate with the value of suggestions received. Evidence of intelligent thought, although not resulting in practical improvement, is not passed by. Many of the suggestions received are practicable, some are valuable, and generally they indicate the thought and intelligence that a considerable number of workmen give to their everyday surroundings of employment in the Company's service.

Apart from work-a-day occupation, there are other means

of promoting that mutual understanding and sympathy that it is so desirable to achieve. I refer to the promotion and encouragement of athletic sports, which do so much to bring all classes together, as well as indoor gatherings of which the employees of the Gas Light and Coke Company have had much pleasant experience.

Education of Gas-Workers.

The allusion I made to educating the co-partners reminds me that the National Joint Industrial Council for the Gas Industry, with representatives of the Institution and the Board of Education, are interesting themselves in the education of gas-workers, in so far as their immediate occupation is concerned; and information is now being collected on which to base a scheme that will be generally applicable. Nothing but good can result from the operation of such a scheme, which is unanimously approved by both workers' and employers' side of the Council; and I trust it will be thoroughly well supported, if only from the fresh interest it will bring to the worker in the performance of his task which, carried on daily throughout a long period of time, must become monotonous in the extreme. We already have experience in the Gas Light and Coke Company of lectures to gas-workers, which were instituted for the purpose of extending the knowledge of men wishing to qualify for promotion, and they have been in every way successful, not only attracting the men for whom they were primarily intended, but many others who are attracted from the mere love of adding to their stock of information on the subject of the work in which they are engaged.

A Gas Engineer's Training.

I am frequently asked for advice as to the training necessary for the intending gas engineer. As to this, seeing that the whole manufacture and purification of gas is merely a matter of chemical engineering, it is evident that the engineer who devotes himself to gas manufacture must have more than a nodding acquaintance with the science of chemistry, so far as will comprise a knowledge of the various actions and re-actions that take place in the general course of manufacture. He need not specialize in chemistry; but he should have so much knowledge of chemistry as will enable him to supervise the various chemical operations coming under his superintendence. For chemical operations beyond this, partaking of research, calling for closer knowledge of the science and practice of delicate chemical manipulation, he had best rely upon experts who make chemistry their profession.

It is becoming more and more needful, however, that the gas engineer should be an engineer in the true sense of the term, and not merely a superintendent of gas-works. The installation and equipment of the modern gas-works is very different from the works of earlier days, when the operations incidental to the manufacture of gas were far simpler than they have since become. The employment of labour-saving machinery, whether in the yard or in the retort-house, due to the scarcity and the high cost of labour, calls for a thorough knowledge of mechanical engineering, while the knowledge of structural engineering necessary efficiently to deal with the design and erection of the much larger and loftier buildings that are now required to house plant is evident, unless these matters are to be left entirely to the contractors to whom the work of erection is entrusted, or the services of a consulting engineer are called in.

Gasholders are of much greater capacity than they used to be, as also are purifiers. It is now usual to house the latter in buildings adapted to the economical handling of materials. In some of the larger works having water frontage, important engineering works in the nature of wharves and piers, carrying coal-unloading plant, are involved. The extensive adoption of electric current in gas-works for the purpose of operating machinery, also adds to the engineering knowledge required, involving as it frequently does the installation of plant and appliances for generating the needed current.

If engineering knowledge was required in our works "pre-war," how much more is it required now, and how much more will it be likely to be required henceforward, in view of the decreased value of money, and the enormously increased cost now involved in the installation of every description of building or plant? The judgment with which such buildings and plant are selected and designed, as well as the matter of their arrangement and erection, will affect profoundly the ultimate cost and efficiency of the particular functions of manufacture in which they are intended to be employed.

Apart from the improvement in the status of the engineer who designs his own constructional and engineering work is the freedom from those annoying additions to the account for "extras," arising out of the contractor in the first place having cut his quantities in the absence of knowledge of what his competitors may be tendering for, and his desire during the carrying-out of his contract to make good deficiencies which subsequently become obvious. Besides this, the waste must be considered of the expense incurred by a number of contractors, each making his own drawings and specifications, and taking out his quantities, for all of which at some time or another the unsuccessful contractors have to recoup themselves out of the pockets of their clients. I am not referring to the designs of special plant, such as vertical retorts, retort-charging machinery, transporters, or other appliances of a kindred nature, where obviously an engineer must place himself in the hands of reputable firms, well-known to our members, who may be fully trusted to carry out their obligations in the highly efficient manner with which the majority of us are so well acquainted.

The subject is one of extreme importance to the Institution and the industry; and I trust the time is not far distant when admission to membership will be preceded by investigation by an Examining Board of the Institution, the function of which will be to adjudicate as to the professional qualifications of candidates—subsequently reporting to the Council for their guidance in finally dealing with the applications of candidates for election.

Association of Technical Gas Officials.

The pity of it is, that the remuneration of so many responsible engineers throughout the country is so poor as to have created the need for an Association of Technical Gas Officials in order to guard their financial interests. I heartily wish the work of this Association every success in the object they have in view of creating a better practical knowledge where it is necessary, and a more correct appreciation of the valuable services rendered by engineers superintending the manufacture and distribution of the gas produced in their several areas of supply. The qualifications called for are considerable, for in addition to the engineer and chemist there is the necessity for no little business ability if the gas engineer is to be successful in the sphere of occupation which he has chosen. It is an exceedingly short-sighted policy that such a one should not receive full recognition of his service to the community, which is so whole-heartedly rendered as by the members of our industry in the manufacture and distribution of gas.

Conclusion.

The branch of engineering that we follow is one of exceeding interest and public utility. It should from these facts alone attract into its ranks well-educated young men possessing the energy and ambition to carry on the tradition of the Institution and the industry. My concluding remark is to commend to the earnest consideration of those concerned that unless adequate financial recognition is given to well-trained and zealous service, the right stamp of man will not be secured—to the prejudice alike of the public and the industry, to the maintenance of which in the foremost ranks of engineering the members of this Institution devote themselves by all the means in their power to uphold.

An Institution of Chemical Engineers.

At the Annual Dinner of the Chemical Engineering Group of the Society of Chemical Industry on Tuesday last week (May 31), Professor J. W. Hinchley referred to the formation of a professional organization of chemical engineers. He pointed out that, when the group was originally formed, the question was discussed as to whether they should not form a separate body to deal with the interests of chemical engineers as a whole; but it was then decided that the time had not come for this. He was certain, however, that if an Institution of Chemical Engineers were not started in London next year it would be started somewhere else—judging from the requests from people all over the country. He was convinced that an Institution of Chemical Engineers, if formed, would put the profession on a firm basis, and deal with many of the problems the group was now trying to deal with, and could deal with professional matters in a more satisfactory manner than could the group. In the course of the dinner an expression of opinion from those present as to the desirability of forming an Institution of Chemical Engineers was ascertained; and practically unanimous help was offered in the formation of such an Institution.

STEAMING IN VERTICAL GAS-RETORTS.

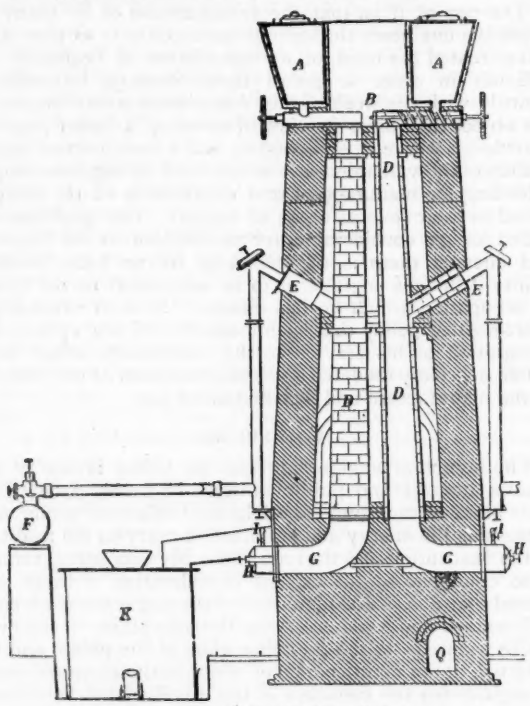
By Sir GEORGE BEILBY, F.R.S., Director of Fuel Research of the Department of Scientific and Industrial Research.

[A Paper prepared for the Annual Meeting of the Institution of Gas Engineers.]

INTRODUCTORY.

Forty years ago, the first firebrick vertical retorts were erected at the Oakbank Works, Midlothian, for the recovery of the fixed nitrogen of carbonaceous residue as ammonia by the use of steam, at a temperature of 800° to 900° C. The function of the steam was to oxidize the carbon, to set free the fixed nitrogen in the presence of nascent hydrogen, and to preserve the ammonia thus formed from dissociation at temperatures above 500° C.

This process involved the burning-away of the greater part of the fixed carbon, and the production of large volumes of water gas which, after separation of the ammonia, could be used as fuel. For the efficient protection of the ammonia in the hot retort, a large excess of steam had to be used, the excess (which ultimately condensed as water) amounting to over 100 p.ct. on the weight of coal. Owing to the large amount of heat which had to be supplied through the walls of the retort for the incineration of the carbon by steam alone, it was ultimately arranged to supply sufficient air with the steam to consume about one-half of the fixed carbon by oxygen, and only one-half by steam. The output of a given retort was thereby much increased: and, if the temperature and the steam supply were properly adjusted, the yield of ammonia was still satisfactory. The gas produced now contained about 35 p.ct. of nitrogen, and its calorific value was correspondingly reduced. But it was still an excellent fuel gas, owing to the high percentage of hydrogen it contained. These Oakbank retorts and their performances were fully described in a series of papers published between 1883 and 1885.*



Cross Section of the Oakbank Retorts.

For a lettered description of this illustration, see "JOURNAL," Vol. XLII. (1883), p. 928.

In the earlier papers, the thermo-chemical aspects of the problem were dealt with, and thermal balance-sheets were worked out which were in fair agreement with the working results.

The illustration is a vertical cross-section of a setting of these retorts. The retorts, of which there were twelve in the setting, were of oval cross-section, and were built of grooved and tongued firebricks. The bricks were bedded in a thin fireclay cement, to which a certain proportion of common salt had been added. Each retort was self-contained; being closed at the bottom by a faced door, and at the top by a hopper and charging door. The steam and air were blown in at the upper side of the mouthpiece, and passed-up through the hot coke in the lower half of the retort. The gases passed-off by an exit-pipe built-in half-way down the retort; the carbonization gases having to pass through red-hot coke on their way to the exit pipe. The setting was fired by a portion of the cooled, washed gas. The gas-producer in front was only used to heat-up the setting. As the carbon burned away, the whole column gradually sank down, making room for fresh coal to be introduced at its upper end. At intervals the bottom doors of the retorts were opened, and the ashes and fine cinders were removed.

The following was given as an average analysis of the gas produced:

	P.Ct.
Carbonic acid	15·40
Carbonic oxide	10·70
Hydrogen	34·53
Marsh gas	4·02
Nitrogen	35·33

The yield of ammonia averaged 120 lbs. of sulphate per ton of coal; and the average amount of liquor produced was 250 gallons per ton. This may be taken as the measure of the excess of steam used; being rather more than 1 lb. of steam per pound of coal gasified. The retorts were worked at an external temperature of 900° to 1000° C. Though some of the gas engineers of those days followed this new development with interest, the time had not arrived when it could be regarded as having any direct bearing on the gas industry. The interest which did ultimately arise in the vertical retort practice in Scotland had nothing whatever to do with steaming and its bearing on ammonia recovery. Gas engineers were really attracted by the mechanical possibilities and low working costs of the vertical gas-retort, as these had become developed in connection with the shale industry. The introduction of the vertical retort to the gas industry took place early in the present century, owing to the pioneering work of Young and Glover, and of Woodall and Duckham in this country, and of Bueb in Germany.

In concluding this preliminary review, I would remind you of the movement in favour of carbonization at higher temperatures as the most obvious means of increasing the output of gas per ton and per mouthpiece, and of the parallel development in the use of enriched water gas as a convenient means of meeting the sudden fluctuations in demand for which the works engineer must always be prepared.

The vertical retort, in common with the horizontal and inclined types, shared in the high-temperature movement. To meet the more exacting conditions, highly refractory bricks had to be employed, greater care had to be exercised in fitting them together with the minimum use of cementing material, and last, but not least, steel had to play an increasingly important part in the structural work of the setting. As a consequence of this, the vertical retort has become a very costly piece of apparatus, which is still decidedly less fool-proof than the horizontal settings of earlier years.

Thus it has naturally come about that the possibility, by steaming, of still further increasing the output of gas per retort, and of thereby reducing the heavy capital and on-cost charges, has acquired a new attraction for the gas engineer.

THE ASSOCIATION OF THE FUEL RESEARCH BOARD WITH THIS INQUIRY.

Within six months of its establishment in January, 1917, the Fuel Research Board were asked by the Board of Trade to advise on the future policy in regard to gas standards. The history and results of this inquiry are so well within the knowledge of this Institution, that there is no need to enlarge on the subject. The inquiry naturally led the Board to review, in a more intimate way than had been their intention under their first scheme of research, the wider relations of the gas industry to the national question of coal conservation. Among other aspects of this question, the methods were closely considered by which a larger proportion of the potential heat units of the coal carbonized in gas-works might be made available in the form of gas. My early association with the production of fuel gas and ammonia from bituminous coal by steaming in vertical retorts had naturally led me to follow with interest the recent developments in this direction in the gas industry; and early in 1918 it became evident to the Board that the study of this subject should find a place in the programme of the Research Station. In conjunction with Mr. W. H. Burton, who was associated with me in the designing of the station, a careful study was made of the leading types of vertical retorts which were then on the market. The Glover-West retort, owing to its provision of means by which the temperature from top to bottom could be controlled by a series of horizontal combustion chambers, was selected as the most suitable for our immediate purpose; and negotiations were entered into with Messrs. West, and their designs carefully studied from our point of view.

It was decided that a setting of four retorts, capable of carbonizing 10 tons of coal per day, would be most suitable, as this was the unit of throughput which had been adopted in the Fuel Research Station. As much of the proposed experimental work involved the preparation of really accurate thermal balance-sheets, the general methods of firing and temperature regulation which had been adopted in the station had to be applied to the vertical retort setting; and Messrs. West's designs had to be

* "Trans. Mining Inst. of Scotland," Vol. V., Part 5, p. 158. "Soc. Chem. Ind. Jour.," April, 1884, Vol. III.

modified accordingly. The special features of the ultimate design included:

(*a*) The firing of the setting by washed fuel gas supplied under constant pressure from an outside source, and the measurement and regulation of the gas supplied to each of the seven horizontal combustion chambers of the setting.

(*b*) The supply and regulation of the air required for combustion under a uniform positive pressure.

(*c*) The pre-heating of the air supply by the outgoing flue gases at the top of the setting in an exchanger built of steel pipes.

(*d*) The provision of a gas-fired independent steam-boiler close to the setting, so that the steam could be accurately weighed into the retorts.

Messrs. West concurred in these and other modifications; and in May, 1918, the contract for the erection was duly signed. The inclusion of the vertical retort-setting in the lay-out of the station involved the modification and extension of the original plans of the station, then in course of erection.

Owing to the general delay in the erection of the station, which arose from war conditions and from foundation difficulties on the site, the steel structural work of the setting was only completed early in 1919; and the building of the retorts and flues was carried out by the contractors during the following summer, under very favourable conditions. The setting as completed was in every way satisfactory from the constructional point of view.

Early in 1920, the organization of the station and its staff had reached the stage when the vertical retort inquiry could be safely undertaken. Thus, from the initiation of this investigation till its actual beginning, a period of over two years had actually elapsed. During this period, steaming in vertical retorts had made good progress; and many striking results had been reported by independent gas engineers. In October, 1917, Mr. J. E. Blundell, of Macclesfield, read a paper on "Some Experiments on Steaming in Continuously Operated Vertical Retorts," before the Manchester District of Gas Engineers,* in which he gave his experiences in the use of steam in Glover-West retorts. The results are set out with convincing clearness and brevity, and from the outset of our own inquiries have been regarded by us as of great value. The Macclesfield experiences will be referred to in what follows. In November of the same year, Mr. John West read a paper before the Southern Association of Gas Engineers and Managers,* in which some interesting records of steaming tests in vertical retorts are fully described.

In both these sets of experiments, very high temperatures were used; the aim evidently being to keep the carbonic acid in the gas under 4 p.ct. For the same reason, it would appear that only moderate percentages of steam were used. In comparing the results of these tests with those obtained at the Fuel Research Station and at Uddingston, these facts must be taken into consideration.

The beginning of 1920 saw the completion of the tests undertaken by the Gas Investigation Committee of this Institution at Uddingston; and their report was received and discussed at the meeting a year ago.

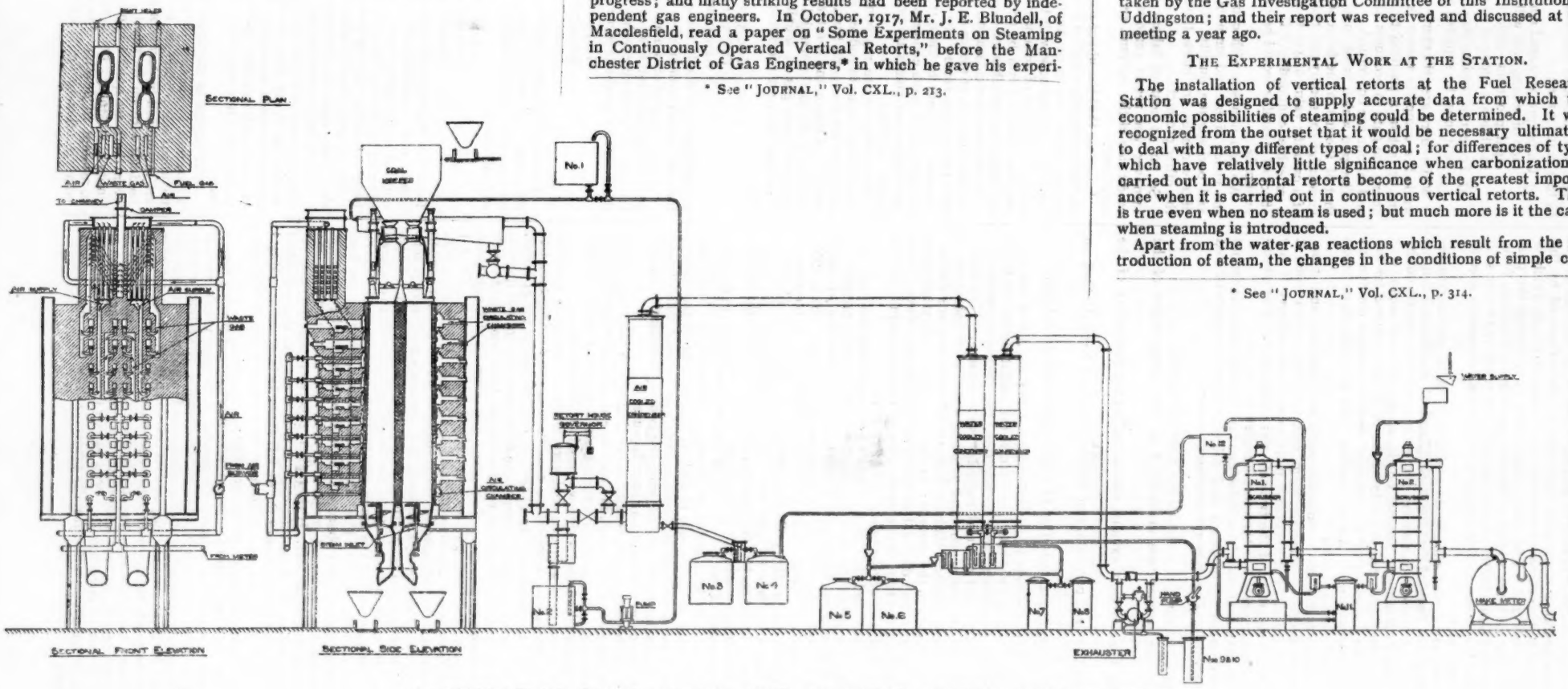
* See "JOURNAL," Vol. CXL., p. 213.

THE EXPERIMENTAL WORK AT THE STATION.

The installation of vertical retorts at the Fuel Research Station was designed to supply accurate data from which the economic possibilities of steaming could be determined. It was recognized from the outset that it would be necessary ultimately to deal with many different types of coal; for differences of type which have relatively little significance when carbonization is carried out in horizontal retorts become of the greatest importance when it is carried out in continuous vertical retorts. This is true even when no steam is used; but much more is it the case when steaming is introduced.

Apart from the water-gas reactions which result from the introduction of steam, the changes in the conditions of simple car-

* See "JOURNAL," Vol. CXL., p. 314.



I.—DIAGRAM OF PLANT AT H.M. FUEL RESEARCH STATION, EAST GREENWICH.

bonization which result from the redistribution of the temperature zones within the retorts, and the more rapid removal of the volatile products of carbonization, are greatly influenced by the physical and chemical characters of the particular coal which is being carbonized. The coals which were used during the past year were of three widely different types—from Durham, Yorkshire, and Lanarkshire; but it was fully recognized, as I have said before, that a much wider range of coals would ultimately need to be dealt with.

From my earlier experience of the working of continuous retorts, it was decided that the most practical starting-point for a series of trials with increasing percentages of steam would not be an entirely steamless test, but one in which 5 p.ct. of steam was used, as this appeared to me to be the minimum required for the satisfactory working of any form of retort in which continuous drawing was in use. All our earlier tests were therefore made from this starting-point.

As our experimental results accumulated, however, and it became desirable to correlate them with the Uddingston tests, it was recognized that steamless tests would be necessary if any proper comparison of the two sets was to be made. The steamless starting-point was therefore adopted.

For each coal tested it was decided that the only variable should be the percentage of steam used, calculated on the weight of coal carbonized. The constant conditions were:

(1) The throughput of coal per retort per hour.
(2) The temperature maintained in the seven stages of the setting.
(3) The degree of exhaust maintained at the gas-outlets of the retorts.
(4) The fixed percentage of steam which had been decided on for each test.
(5) The general condition of condensation and scrubbing.

The station report which follows gives full details of the precautions which were taken to ensure the maintenance of these constant conditions, and, in addition, the means by which accurate weight and thermal balances were secured. This report shows the amount of care and patience which were necessary to obtain these results. Failures and partial successes are deliberately included in the records; so that the experts who study them may have at their disposal so complete a knowledge of everything concerning the tests that they may be in a position to judge of the value and trustworthiness of the final results.

The Board feel that they cannot too strongly express their appreciation of the devotion and enthusiasm of every member of the staff who has taken part in this work, the direction of which was in the hands of Engineer-Commander J. Fraser Shaw, R.N., ably supported by Dr. Thomas Gray, Chief of the Laboratories, by his successor, Mr. J. G. King, and by Mr. A. Blakie, Mr. W. J. Skilling, and the other members of the scientific staff. The carbonizing foreman, Mr. G. Percival, and his staff have throughout entered into the spirit of the inquiry.

The report of the Research Sub-Committee on the Uddingston tests has been kept before us throughout these tests; and every endeavour has been made to lay-out the records of our experimental work as far as possible on lines which would make it easy for gas engineers to gain as much trustworthy information as possible from the results of our joint labours.

With this object, the results of the Uddingston tests have been included in Table I.; and, in order to establish a bridge between the two sets of experiments, some tests have been carried out with the Lanarkshire coal which was used at Uddingston.

The first tests with this coal were made as nearly as possible under the same temperature conditions as at Uddingston, but with a throughput of only 2½ tons of coal per retort for 24 hours. As the yields obtained under these conditions did not fall quite in line with the Uddingston results, further tests were made with approximately the same throughput per retort as at Uddingston—namely, 3·26 and 3·68 tons per retort per 24 hours. Tests J and K, which compare with tests 1 and 3 at Uddingston still, however, show considerable discrepancies which are not easy to explain, as the analyses indicate that the coals used were practically identical. Two possible reasons may be suggested. These are the wider discrepancies in the weight balances which occurred at Uddingston, and the much less uniform heating of the individual retorts. At the Fuel Research Station, each of the four retorts took its full share of the carbonizing work; the same amount of coke being continuously withdrawn from each. We understand from Mr. Hislop that this was not the case at Uddingston, but that differences in temperature in the individual retorts had to be allowed for by adjustments in drawing. May I venture to suggest that uniformity of heating is not an unattainable ideal, even in everyday practice?

My colleagues and I welcome this opportunity of placing before you at the earliest moment the results of the past year's work at H.M. Fuel Research Station on the steaming of vertical retorts. Our only regret is that its completion had to be hurried to suit the date fixed for the meeting; and its revision has therefore not been so thorough as it would otherwise have been. For the same reason, it has not been possible to present with any approach to completeness our conclusions as to the inquiry and suggestions as to its further development. The report is now, however, in your hands; and you will naturally prefer to draw your own conclusions.

The Immediate Results of the Inquiry.

The two questions which have been in all our minds with respect to this inquiry are:

(1) Under pre-arranged conditions of temperature and percentage of steam, how will the yields and qualities of the principal products—gas, tar, coke, and ammonia—be affected in different types of coal?
(2) To secure the increased yields of products, how much extra heat must be supplied to the retorts?

While there are still many obvious lacunæ in the experimental work, if a complete answer is to be given to these questions, we are at last in a position to speak with considerable confidence about the gain in products and the cost of this gain so far as fuel and labour are concerned.

The gain which is of most importance to the gas industry is that of therms in the form of saleable gas. It has been common knowledge for some years that this gain was an assured one if gas of a calorific value of 400 to 450 B.Th.U. could be established as a saleable commodity. It was not equally certain what the effect of steaming would be on the other products—tar, coke, and ammonia.

We can now say with confidence that there are also gains in the yields of tar and ammonia. Some sacrifice in the quantity, and perhaps the quality, of the coke must be faced; but these disadvantages are more than compensated for by the gains in the other products.

So far as cost of labour is concerned, the greatly increased turnover per retort removes this item from the debit to the credit side of the account, even if more highly skilled workers are employed.

I assume that the upper limits to which steaming can be carried economically must be definitely determined for the particular coals which are most available in each district. It is wiser, therefore, to deal now with the more general principles, as these apply to the use of so moderate a percentage of steam that we may feel sure it could be economically applied to all coals which are otherwise suitable for carbonization in vertical retorts.

In my own consideration of the subject, I have provisionally adopted 20 p.ct. of steam as this figure, as we are now in a position to pass in review the results from the application of this amount of steam to three, or possibly four, types of coal. For my own use, I have condensed the data into a form in which the most important points are presented as simply as possible, and in round numbers.

These figures are reproduced, in the hope that you may find them useful as an introduction to the more elaborate tables and graphs in the Research Station report. They illustrate that, with 20 p.ct. of steam and a retort temperature of 1248°, as much as 33 p.ct. of the total potential heat of the Mitchell Main coal was converted into gas of a calorific value of 460 B.Th.U. per c.ft. The total gains on the three volatile products from 1 ton of coal were:

Gas, 33 therms
Tar, 34 lbs.
Ammonium sulphate, 6 lbs.

To produce this result, the extra heat supplied in the forms of fuel and steam amounted to 10 therms.

With 20 p.ct. of steam and a retort temperature of 1177°, 29 p.ct. of the total potential heat of the Lanarkshire coal was converted into gas of a calorific value of 432 B.Th.U. The gains on the three volatile products were:

Gas, 19 therms
Tar, 40 lbs.
Ammonium sulphate, 11 lbs.

The corresponding figures obtained from this coal at Uddingston were—26 p.ct. of the total heat of the coal was converted into gas of a calorific value of 447 B.Th.U.; and the gains per ton of coal were:

Gas, 17 therms
Tar, 39 lbs.
Ammonium sulphate, 2 lbs.

From the Macclesfield results, with a retort temperature of over 1300°, and a considerably smaller percentage of steam, we are entitled to conclude that under the same conditions as existed in the case of Mitchell Main coal the all-round efficiency would have been at least as high as was obtained from that coal.

The Consett coal is obviously less suitable for steaming; yet the results show a very satisfactory all-round gain.

This brief analysis of the experimental results supplies satisfactory answers to the two questions with which we started, and enables us to say with confidence that, by moderate steaming at moderate temperatures, the output of therms in the form of gas of good and saleable quality from a unit plant can be greatly increased, while the cost per therm will be correspondingly reduced.

With regard to the upper limits of steaming, we are not yet in a position to speak with equal confidence even on the purely technical side; while on the economic side so many new factors are introduced by local conditions that each individual case must be dealt with on its merits. On the purely technical side, however, there are quite a number of indications as to the practical limits of steaming; but it would lead us much too far if we were to attempt to develop the subject now. I would merely direct your attention to the rapid falling-off in the effect of each indi-

Increased Yields from 1 Ton of Coal by Steaming.

—	Consett.	Mitchell Main.	Lanarkshire.		Yorks. ?	—
	Fuel Station	Fuel Station	Fuel St tion	Udding-ston.	Maccles-field.	
	1260° 1248°	1267° 1248°	1209° 1177°	1211° 1177°	1300°?	
Steam used . .	21	21	22	22	?	Per cent.
Gas	79	104	80	68	79	Total therms
Gas therms % on coal. . .	26%	33%	29%	26%	24%	Therms per cent.
Gas gained . .	11	33	19	17	15	Therms.
Tar gained . .	17	34	40	39	60	Pounds.
Sul. Am. gained	7	6	11	2	6	Pounds.
Extra heat in fuel and steam	8	10				Therms supplied
Gas—cal. value {	510 463	544 460	518 432	544 447	530 510	Without and with steam.

vidual per cent. of steam after the limit of 20 to 25 p.ct. has been reached.

REPORT ON STEAMING IN VERTICAL GAS-RETORTS AT H.M. FUEL RESEARCH STATION.

A series of tests on the steaming of Lanarkshire coal at Uddingston Gas-Works has been carried out by the Gas Investigation Committee of the Institution of Gas Engineers; and their most interesting report has been published. The work carried out at the Fuel Research Station covers similar ground to the Uddingston tests; but more attention has been directed to the practical issues of the problem as affecting the gas industry, as distinct from purely chemical considerations.

The object of the work has therefore not included, as at Uddingston, the preparation of chemical balances of the several elements in the coal or their distribution in the products of carbonization; and attention has been concentrated on the practical effects of steaming on thermal efficiencies and yields. Similarly, any investigation into the course of the steam-carbon reactions in the retort or the actual heat of carbonization of the coal has been deferred.

In order that the greatest use might be made of the results obtained in these independent investigations, it has been considered advisable to extract the Uddingston facts and figures for comparison with those of the Research Station. To make this comparison more direct, two tests have been carried out with coal from the same source as that used at Uddingston.

The main results obtained in all the tests have been tabulated in Table 1, in parallel with the figures translated from the Uddingston report.

PROGRAMME OF TESTS.

The programme of the tests carried out included:

(*a*) The determination of the heat required to maintain the settings at carbonizing temperatures with no coal passing through the retorts. This test has been designated the "Test for determination of heat losses from setting;" and the quantity of heat required will be known as the "heat equivalent" of the setting.*
This test is fundamental, and a similar test, or one from which the results obtained in this case can be calculated, must be carried out at any gas-works where it is hoped to make full use of the results obtained at the research station.

(*b*) The carbonization of a throughput of 10 tons of coal per day in the four retorts under constant conditions; the only variable being the use of steam to the extent of 0 p.ct., 5 p.ct., 12 p,ct., 20 p.ct., and 30 p.ct. by weight of coal carbonized, which necessitated the determination and examination of all the products of carbonization in each case.

(*c*) The carbonization of Lanarkshire coal in the four retorts under conditions made to approximate as nearly as possible to those at Uddingston during the tests carried out there.

During the tests, observations have been made by which it is possible to allocate the exact use or dissipation of the heat supplied to the retort and settings, whether to carbonization of coal or radiation, convention, and conduction from settings, or to flue gases. These details are set out in the tables, and form a commentary on the efficiency of the retorts and on the efficiency of the use of steam in retorts.

* After the diagrams had been printed off, it was recognized that the term "net heat expenditure of the setting" would have been more suitable than "heat equivalent." It was too late, however, to effect the necessary alteration to the present report.

In tabulating and making graphic representations of these results, the object aimed at has been to supply information with regard to the result of "steaming" typical coals in such a form as to be immediately useful to those concerned in the manufacture of gas and in the supply of coal to gas-works. While it is realized that these results will probably vary for each individual coal, it is felt that the general conclusions drawn from the results of the distillation of these typical coals are true for other coals. On the other hand, it should be possible to arrange for detailed information to be obtained at the Research Station for any particular coal, if this be desired, provided that the inquirer or inquiring body cares to supply the coal.

In order that the results to be expected from the carbonization of similar coal in a gas-works setting may be ascertained from the results obtained at the Fuel Research Station, it will appear that a knowledge of the "heat equivalent" of his own settings is essential to the works engineer. The test for determination of the "heat equivalent" of a setting is a short and simple test which can be carried out easily and with very considerable accuracy at any gas-works.

If, however, such a test cannot be conveniently carried out, the "heat equivalent" of the setting can be obtained as a difference by carrying out a test in which a definite quantity of coal is carbonized, and either no steam or a definite quantity of steam is supplied to the retorts. From the heat expenditure during this test, and with the use of figures obtained from the graph of the coal in question [see figs. II., III., and IV.*], it is possible to obtain the required "heat equivalent" by difference. This, however, is much less satisfactory than the direct determination.

DIFFICULTIES OF TESTS AT COMMERCIAL GAS-WORKS NOT MET WITH AT H.M. FUEL RESEARCH STATION.

At no ordinary gas-works is it possible (without a prohibitive expenditure) to arrange for the exact measurement of coal, steam, and water supplied to any particular unit, and of the products of carbonization obtained from that unit. This difficulty apparently was not overcome altogether, even during the tests carried out at Uddingston, as shown by the results of the weight-balances calculated from the published figures—*i.e.*, weight of coal and steam entering the retorts compared with weight of gas, tar, and liquor leaving the retorts. These show a varying loss of from 4·7 to 13·5 p.ct.

At the Research Station, the arrangements for measuring the products of carbonization, &c., are very elaborate, and have resulted in a very satisfactory series of weight-balances, in which the results range from a gain of 1·4 p.ct. to a loss of 2·4 p.ct. During the tests these weight-balances were made up for each day, and so served as a useful check on the uniformity of the daily runs.

GENERAL DESCRIPTION OF PLANT.

The report then goes on to describe fully the plant. The settings are of the normal Glover-West type. There are four retorts 21 ft. by 33 in. by 10 in., of a nominal capacity of 2½ tons throughput per day each. They are arranged in pairs; separate combustion chambers encircling each pair. After passing through these chambers, the flue gases are led through a special air preheater which was put in according to the design of the Director of Fuel Research. In order that full use may be made in each combustion chamber of the gas supplied to that chamber, it is essential that the whole setting should be under a slight pressure. The gas used for heating the retorts is water gas of approximately from 300 to 310 B.Th.U., supplied from holders which throw a pressure of 3½ in. water. The air for combustion is supplied under pressure by means of a steam-driven air blower. By the advice of West's Gas Improvement Company, it was arranged to maintain a working temperature of 1250° to 1300° C. in each of the combustion chambers. This gives a temperature of 1030° to 1110° C. entering the flue gas circulating chambers at the top of the setting, a temperature of from 850° to 950° C. on the flue gas entering the preheater, and from 450° to 560° C. on the flue gas leaving the preheater. Steam required for the retorts is generated in a small vertical gas-fired boiler, which is placed close to the foot of the retorts, and is connected only to the retorts. The coal is measured, and so is the coke discharged. A system of circulating liquor and tar through the collecting main was instituted from the beginning.

CONDITIONS UNDER WHICH TESTS WERE MADE.

In the series of tests A to H, a constant throughput (10 tons per day) and constant temperature in the combustion chambers (1250° to 1300° C.) were aimed at; also the pressure in the collecting main was kept as constantly as possible at a level gauge. The only variable was the percentage of steam supplied to the retorts.

In changing from one test to another, the practice was to approximate to the necessary alterations in heat and steam supply as rapidly as possible, and then to allow about 48 hours, which was found to be ample, for tuning-up to the correct pitch, with a further 24 hours under the fixed conditions before the new test commenced.

By this time the temperatures of the combustion chambers had settled to an average of 1260° C., the coal throughput had steadied down to approximately 2½ tons per retort per day, and the tar and

* These graphs will more appropriately be included in the second instalment of Sir George Beilby's paper—to appear next week.—ED. "G.J."

TABLE 1.—*Main Details of Tests.*

Setting	Fuel Research Station.								Uddingston Gas-Works.						
Coal	Consett.			Mitchell Main Gas Nuts.					Lanarkshire Main and Ell.						
Test number	A	B	C	D	E	F	G	H	J	K	1	2	3	4	5
Duration of test in hours	120	120	120	120	120	120	120	120	72	68	193·83	192·0	168·0	168·5	216·25
Average temperature of combustion chambers	1260° C.	1248° C.	1248° C.	1267° C.	1261° C.	1265° C.	1248° C.	1262° C.	1209° C.	1177° C.	1211° C.	1139° C.	1177° C.	1186° C.	1090° C.
Pressure in collecting main	*Nil*	*Nil*	*Nil*	0·1 in.	*Nil*	0·1 in.	*Nil*	*Nil*	*Nil*	*Nil*	0·02 in.	0·10 in.	0·16 in.	0·20 in.	0·20 in.
Carbon dioxide per cent. in waste gases	17·7	16·7	16·9	16 1	16·2	16·6	15·6	16·5	15·0	17·1	19·0	17·7	9·1	9·3	9·3
Excess air per cent. to combustion chambers	12·9	20·0	21 8	25·4	23·5	23·6	32·0	24·4	38·4	21·0	10·4	19·1	38·9	41·5	45·8
Result of weight balance: Loss per cent.	0·03	0·07	2·42	−0·51	0·06	0·49	0·24	2·34	−1·44	1·91	4·74	9·86	10·75	9·96	13·28
COAL—															
Total coal carbonized in tons	49·73	50·44	49·95	50·41	49·62	51·30	49·67	50·27	39·18	41·70	202·15	209 65	207·5	193·05	223·75
Coal carbonized per retort per day in tons	2 49	2·52	2·50	2·52	2·48	2·56	2·48	2·51	3·26	3·68	3·13	3·28	3·71	3 44	3·10
STEAM—															
Total steam to retorts by direct weighing in tons	*Nil*	2·64	10·45	*Nil*	2·51	6·38	10·20	15·10	*Nil*	9·19	*Nil*	28·0	45·9	63·2	100·1
Percentage of steam by weight of coal carbonized	..	5·24	20·95	..	5·06	12·44	20·53	30·03	..	22·05	..	13·3	22 1	32·7	44·8
Diameter of orifice in steam diaphragm	..	3/4 in.	1/2 in.	..	3/4 in.	1/2 in.	1/2 in.	1/2 in.	..	1/2 in.	..	1/2 in.	1/2 in.	1/2 in.	1/2 in.
Pressure of supply to orifice in lbs. per square inch	..	18	21	..	17·0	5·0	11·5	21 5	..	23·4	..	Normal	5·16	10·02	15·20
Pressure at boiler in lbs. per square inch	..	50	47	..	52	60	64	54	..	60		84	84	85	81
GAS—															
Total gas made in cubic feet (saturated at 60° F. and 30 in.)	659,900	685,900	854,100	660,300	815,300	1,029,000	1,121,000	1,289,000	462,700	767,900	1,893,600	2,655,400	3,158,600	3,439,000	4,384,000
Gas made per ton of coal in cubic feet	13,260	13,590	17,080	13,100	16,430	20,060	22,580	25,610	11,800	18,450	9,367	12,665	15,222	17,814	19,593
Heat value of gas made per ton of coal, in therms	68·04	70·40	79·08	71·26	84·9	95·68	103·8	110·8	61·1	79·7	50·95	61·05	68·04	77·67	80·33
Gas made per retort per day, in therms	168·7	177·4	197·7	179·6	210·5	244·9	257·4	278·1	199·2	293·0	159·5	200·2	252 4	267·2	249·0
Calorific value of gas made (gross) in B.Th.U. per cubic foot	510	518	463	544	517	477	460	432	518	432	544	482	447	436	410
Calorific value of gas made (net) in B.Th.U. per cubic foot	451	462	410	476	460	424	410	385	467	386	485	431	401	393	368
Specific gravity of gas (air = 1)	0·347	0·394	0·393	0·370	0·410	0·428	0·442	0·446	0·414	0·447	0·44	0·46	0·49	0·49	0·52
Total inerts in gas (per cent. by volume)	6·9	8 55	8·75	11·35	11·00	10·8	10·6	12·55	11·4	13·0	9·0	10·8	13·0	14·3	16·7
COKE—															
Total coke made, in tons	37·37	37·83	36·45	36·46	34·49	34·13	32·89	32·11	23·95	22·90	120·25	120·95	115·47	101·85	115·67
Percentage of coke on weight of coal	75·2	75·0	73·9	72·32	69·4	66·50	66·22	63·83	61·20	54·93	59·48	57·69	55·65	52·74	51 69
Coke, including breeze, made, in cwt. per ton of coal	15·04	15·0	14·78	14·46	13·88	13·30	13·24	12·76	12·24	10·99	11·90	11·54	11 13	10·55	10·34
Breeze, in cwt. per ton of coal (passing 1/4 in. sieve)	..	..	2·06	2 24	1·86	1·90	1·80	1·78	2·17	2 08	..	..	..	..	..
Volatiles per cent.	0·17	1·06	0·88	0·25	0·31	0·41	0·40	0·06	0·81	2·35	2·3	2·2	2·0	2·2	3·0
Ash, per cent.	13·73	15·00	13·40	10 13	10·09	12·79	10·20	15·48	10·72	12·14	10 1	11·3	13·6	11·5	15·1
TAR—															
Total dry tar made, in gallons	416·0	449 0	501·0	469·0	574·0	576·0	618·0	630·0	552·0	745·0	2648·4	3438·2	3486·0	3938·2	4743·5
Dry tar made, in gallons per ton of coal	8·4	8·9	10·0	9 3	11·6	11·2	12·4	12·6	14·1	17·9	13·2	16·4	16·8	20·4	21·2
Specific gravity of tar	1·16	1·145	1·148	1 106	1·108	1·109	1·095	1·110	1·081	1·077	1·083	1·083	1·082	1·081	1·082
AMMONIUM SULPHATE—															
Water supplied to scrubber in gallons per ton of coal	13·4	13 1	12·2	10 7	11·6	7·75	11·3	6·65	10·57	12·00	19·7	18·7	16·5	17·9	19·7
Total liquor collected in gallons per ton of coal	24 0	29 6	50·3	26·3	26·8	31·1	42·3	46·6	47·9	70·2	53·2	54·2	59·1	76·5	80·4
Strength of liquor collected, in ounces	7 1	6·8	4·7	9·8	8·2	8·1	5·9	5·5	8·1	7·4	7·30	7·25	6·96	5·90	5·82
Ammonium sulphate (pure) in lbs. per ton of coal present in liquor	14 65	17 30	20·0	16·27	18·75	21·8	21·2	21·95	32·6	43·9	32·7	33·1	34·6	38·0	39·4
Ammonium sulphate (pure) in lbs. per ton of coal escaping in gas leaving scrubber	0·30	0·20	1·45	..	0·41	..	1·0	0·15	0·06	0·13	..	..	..	..	..
FUEL TO HEAT SETTINGS—															
Calorific value of blue water gas (gross) in B.Th.U. per cubic foot	300	302	301	308	302	310	311	301	306	301					
Total blue water gas consumed in cubic feet (saturated 60° F. and 30 in.)	719,100	666,000	758,100	748,300	667,900	745,800	797,000	888,000	431,300	442,700					
Blue water gas consumed in cubic feet per hour	5,990	5,550	6,320	6,220	5,560	6,220	6,640	7,400	6,000	6,510					
Total heat value of blue water gas consumed, in therms per hour	17·97	16·76	19·02	19·15	16·80	19 28	20·65	22·41	18·36	19·60					
Heat value of blue water gas supplied to keep settings at carbonizing temperatures, in therms per hour	12 40	12·40	12·40	12·40	12·40	12·40	12·40	12·40	9·60	7·60*	8 4†‡	6·2†‡	7·0†‡	7·0†‡	5·7†‡
Heat value of blue water gas otherwise expended per hour	5·57	4·36	6·62	6·75	4·40	6·88	8·25	10 01	8·76	12 00					
Heat value of blue water gas otherwise expended, in therms per ton of coal carbonized	13·45	10·40	15·91	16·07	10·64	16·11	20·0	23·83	16·10	19·55	15·9‡	17·6‡	19·8‡	22·1‡	25·1‡
Heat value of steam supplied to retorts, in therms per ton of coal carbonized	*Nil*	1·33	5·33	*Nil*	1·28	3·14	5·22	7·63	*Nil*	5·64	*Nil*	3·34	5·60	8·29	11·39

* Estimated. † Using producer gas. ‡ Calculated.

liquor yields had also settled down. A standard test lasted five days; and no test was accepted as such until a satisfactory weight-balance was obtained day after day. In each case at least one confirmatory test was carried out.

In the reproduction of the Uddingston tests with Lanarkshire coal, the conditions with regard to temperature, throughput, and circulation were, of course, varied to suit the conditions which obtained during the corresponding tests at Uddingston.

The action of the plant was kept under strict observation; any irregularity being soon brought to notice and traced to its source by the help of the various figures, when the necessary steps were at once taken to bring matters back to the normal.

The methods of sampling and analysis of coal, coke, gas, tar, liquor, and fuel, and flue gases, are described in detail in Appendix I. which accompanies the paper. The results are tabulated in Tables 3 to 7.

Test for Determination of Heat Losses from the Setting.

This special test was carried out by sealing the doors at the base of the retorts, and then charging the retorts with a weighed quantity of coke. When steady conditions had been obtained, the heat required to keep the combustion chambers at the carbonizing temperature (1260° C.), was ascertained over a period of 48 hours. At the end of this period, the coke was extracted and again weighed; the quantity lost being apportioned to the number of hours which it had been in the retorts. The results of this test are shown in Appendix II., where it will be seen that an expenditure of 12·4 therms per hour was necessary to keep the Research Station setting at this carbonizing temperature. This expenditure of heat will remain a constant throughout all work which is done on the retorts at the same temperature, and will in future be referred to as the "heat equivalent" of the setting.

In expressing the results of the tests graphically, the "heat equivalent" has been subtracted from the total heat supplied in all cases, so that the results given in our diagram can be applied with considerable accuracy to any setting of the Glover-West type when the "heat equivalent" of the installation in question has been determined. This may readily be done by carrying out a test on the above lines, or by carbonizing the coal in a dry state, finding the exact expenditure of fuel gas in that case, and subtracting from the figure thus obtained the corresponding figure given in the diagram for the particular coal in question.

It will be noted that the heat equivalent of the Research Station setting (at 1260° C.)—12·4 therms per hour—is equal to 69 p.ct. of the total heat supplied to the setting when carbonizing Consett coal in a dry state, and 64·7 p.ct. in the case of Mitchell Main gas nuts at a throughput in each case of 2½ tons per retort per day.

This figure is certainly much higher than is likely to occur in a large setting, chiefly owing to the arrangement of the combustion chambers around the retorts, and to the very large end-wall surface in proportion to the number of retorts in the setting. If there were no air-preheater superimposed, the heat equivalent would, of course, be considerably increased.

In order to carry out a comparison with the Uddingston results, it was necessary to obtain the heat equivalent of the Research Station setting at a lower temperature—1210° C. instead of 1260° C. This was found to be 9·6 therms per hour, using water gas.

While conducting these tests, it was felt that atmospheric conditions of wind and temperature affected the results materially. Data on these points were therefore obtained from the neighbouring Royal Observatory; but it was not possible to make any deductions over such short periods.

Description of Coals Used.

Consett Coal.—The coal used in the first series of tests was a Durham coal bearing the trade name of Consett (moisture 1·21 p.ct., organic volatiles 26·78 p.ct., ash 10·90 p.ct., nitrogen 1·30 p.ct.). The percentage of smalls in the coal was very considerable; about 65 p.ct. passing through a 2 ½-in. mesh, and only 16 p.ct. remaining on a 1-in sieve. We are indebted to the South Metropolitan Gas Company for displacing at our disposal a whole cargo of this coal at their East Greenwich works; so that we were enabled to draw from the same cargo for all the tests we required. The retorts were new at the commencement of the series of tests, Consett being the coal with which they were brought into use. After the first few hours, when the combustion chambers had reached a satisfactory temperature, no further trouble was experienced in passing this coal through the retorts at any time during its use at the Research Station. The coke produced was very large, hard, and strong, and appeared to be quite suitable for foundry purposes. The quantity of breeze amounted to 14 p.ct. when carbonized with 20 p.ct. of steam. The yields of gas and other products will be found in Table I.

Mitchell Main Gas Nuts.—The second coal used—Mitchell Main gas nuts (moisture 0·81 p.ct., organic volatiles 30·32 p.ct., ash 6·55 p.ct., nitrogen 1·48 p.ct.)—was a washed coal of even size; about 18 p.ct. passing through a ½-in. mesh, and 34 p.ct. remaining on a 1-in. sieve. This coal was provided by the Mitchell Main Colliery Company, Ltd., Barnsley, through the good offices of Mr. Thomas Glover; and we have to thank the Company for arranging for the very uniform quality of the supply which we have obtained for many months, including the period of the coal strike in October, 1920. The coke formed was of a good average quality, suitable for household purposes, being much more friable than the Consett coke. The percentage of breeze varied from 15 p.ct. of coke made on carbonization in a dry state to 13 p.ct. of coke made when carbonized with 30 p.ct. of steam. This coal has given more trouble in its passage through the retorts than the Consett coal. Not only has scurfing been necessary at more frequent intervals, but during normal working there have been many occasions when the charges have stuck in the retorts. This has occurred more particularly when no steam or high percentages of steam were in use; more satisfactory conditions obtaining with moderate percentages of steam.

Lanarkshire Main and Ell Coal.—The coal used in the third series of tests was from the central coalfield of Scotland (moisture 9·77 p.ct., organic volatiles 32·09 p.ct., ash 7·01 p.ct., nitrogen 1·4 p.ct.), and was supplied as washed nuts of even size; about 15 p.ct. passing through a ½-in. mesh, and 18 p.ct. remaining on a 1-in. sieve. These washed nuts were a mixture of the Main and Ell seams. Our thanks are due to Messrs. Wm. Baird & Co., of the Bothwell Castle Colliery, who at some inconvenience to themselves at once acceded to our request for a supply of coal exactly similar to that used during the tests at Uddingston. The coke formed was small, but of even size; each piece of the original coal being quite distinguishable, and in many cases separate. This was more in evidence with 20 p.ct. of steam, though the proportion passing through a ½-in. mesh remained practically the same as with no steam. The coke was very suitable for boiler, water-gas generation, or household purposes. This coal gave no trouble whatever in passing through the retorts without steam and with 20 p.ct. of steam.

Description of Carbonizing Tests.

The report then gives a detailed description of the carbonizing tests, the results of which are set out in Table I.

The final standard tests marked A, B, C, &c., are individual tests, not the averages of preceding tests. The complete records of the preceding tests are, however, given in every case, in order that the history of the standard tests may be fully known.

Test "*A*."—Consett coal, from July 5 to 10, 1920, was commenced after two days of steady conditions without steam; the last scurfing having been completed on June 23.

Test "*B*."—Consett coal, from June 16 to 21, 1920, was commenced after nineteen days of steady conditions with 5 p.ct. of steam; the last scurfing having been completed on May 11. The first coal was charged into the retorts on April 12; and it was not until May 19 that the retorts were considered to be in a sufficiently steady condition to attempt a preliminary test. The test from June 16 to 21 was actually the fifth attempt to obtain satisfactory results; and it confirmed those previously obtained in the fourth attempt. The previous tests failed to reach the required standard from various causes—either through breakdown of machinery or through adjustment being required in the matter of measuring and collecting the various products.

Test "*C*."—Consett coal, from July 26 to 31, 1920, was commenced after eleven days of steady conditions with 20 p.ct. of steam; the last scurfing having been completed on June 23. In this case very considerable difficulty had to be overcome before a continuous result could be obtained; five previous attempts having been made.

Test "*D*."—Mitchell Main gas nuts, from Dec. 18 to 23, 1920, was commenced after four days of steady conditions without steam; the last scurfing having been completed on Dec. 12. In this case it was found necessary to scurf after an attempt had been made to commence the test. Two days after the scurfing was completed the preliminary test was begun, and was completed satisfactorily in four days.

Test "*E*."—Mitchell Main gas nuts, from Sept. 22 to 27, 1920, was commenced after thirteen days' steady conditions, with 5 p.ct. steam; the last scurfing having been completed on Sept. 5.

Test "*F*."—Mitchell Main gas nuts, from Dec. 1 to 6, 1920, was commenced after three days' steady conditions with 12½ p.ct. of steam; the last scurfing having been completed on Nov. 10. Two previous attempts were made to carry through this test with a mixture of producer gas and coal gas as fuel; but the difficulties met with in obtaining absolutely satisfactory temperatures, and also the alteration in conditions which ensued from the very largely increased volume of flue gases, caused the abandoning of this fuel and a return to water gas as fuel for all tests.

Test "*G*."—Mitchell Main gas nuts, from Oct. 11 to 16, 1920, was commenced after one day of steady conditions with 20 p.ct. of steam; the last scurfing having been completed on Oct. 8.

Test "*H*."—Mitchell Main gas nuts, from Feb. 19 to 24, 1921, was commenced after four days' steady conditions with 20 p.ct. of steam; the last scurfing having been completed on Feb. 4.

Test "*J*."—Lanarkshire Main and Ell nuts from April 9 to 12, 1921, was commenced after one day of steady conditions; the last scurfing having been completed on April 1.

Test "*K*."—Lanarkshire Main and Ell nuts from April 13 to 16, 1921, was commenced after one day of steady conditions; the last scurfing having been completed on April 1.

General Remarks.

Table I.

Table 1 gives a general summary of the main details of the tests carried out at the Research Station and at Uddingston. It will be noticed that in the Research Station tests the

maximum variation in the temperature of the combustion chambers is 20° C. The variation from the desired 50 tons throughput of coal did not exceed 0·6 ton. The maximum variation from the percentage of steam desired did not exceed 0·9 p.ct., and was generally much less than this. The pressure in the collecting main was kept at zero, except in two tests, when it did not exceed 0·1 in. The average percentage of excess air was 24, with only two considerable variations from this figure. The information with regard to the gas made, coke, breeze, ammonium sulphate, tar, &c., has been put in the form it is hoped will be most immediately useful to gas engineers.

It has been considered desirable to give the information with regard to diameters of orifices in the steam diaphragms, together with reduced pressure and boiler pressure, for the information of gas engineers. These data were made use of in calculating the quantity of steam passed into the retorts at Uddingston, but were in no way used at the Research Station, where the water fed into a special boiler was weighed hour by hour.

It will be noted that the comparison between Test "J" and No. 1 Uddingston is very close, except with regard to gas yields. The increased gas yield obtained at the Research Station means also a considerable increase in the therms produced per ton of coal. This increase was confirmed in the preliminary test with a 2½-ton throughput, and may be due to the more even heating of the Research Station setting, though it is partially accounted for by the difference in the respective weight-balances.

The yields obtained in Test "K" are not comparable with those of No. 3 Uddingston, and resemble more nearly those of Test 4, except that the yield of tar is 2·5 gallons less, and that of sulphate 6 lbs. more. The reason for this is, presumably, that the steam supplied to the Research Station setting in Test "K" is decomposed to the extent of 9·6 p.ct. of the weight of coal, compared with 7·2 in Test 3, and 10·6 p.ct. in Test 4. This is confirmed by a comparison of the net amount of liquor formed per ton of coal. The difference in carbonizing temperature between Tests No. 3 and 4 is only 9° C.

The Uddingston figures have simply been rearranged to suit the purpose of this Table, except those marked ‡, which have been calculated from information obtained at the Research Station.

It must be remembered that, for a true comparison, it is essential that the temperatures of carbonization should remain the same in all tests. However, it is thought that useful information can be obtained from the data as given, and from fig. IV., where they are set out graphically.

The report also contains a table in which are set out the details of the temperatures and pressures in the system. We are not reproducing this; but the average temperature of the combustion chambers is given in Table 1.

(To be continued.)

Economic Causes of the Coal Crisis.

There has been reprinted from the April issue of the British Engineers' Association "Bulletin" an article dealing with the economic causes of the coal crisis; and annexed to it are some statistical tables compiled from official and other authoritative sources, and embodying a number of independent calculations. Special emphasis is laid upon the necessity of reducing the price of coal to a figure at which home industries can afford to consume it, and importers overseas can afford to purchase it—a point made by Dr. Bone in a letter which will be found on p. 391 of the "JOURNAL" for May 18. The writer of the "Bulletin" article says it is remarkable that it was not until a very late stage in the development of publicity concerning the coal stoppage that attention was given to the fundamental necessity of reducing the price of coal down to a figure at which our industries could afford to consume it. Any settlement of the coal dispute that did not fulfil this vital condition would be worthless. Surely, it is argued, the first step should be to ascertain, in consultation with representative consumers, the limit prices for the various grades of coal which the different industries of the country can really afford to pay and yet maintain their vitality and their ability to meet foreign competition in the markets of the world. The tables deal with the world's coal output and consumption, output per person employed, wages costs, proportional outputs and earnings, selling prices, financial results, variations in costs per ton disposable commercially, the district incidence of gross profits and direct losses, and coal exports and foreign bunkers. They have been prepared with the object of presenting clearly and concisely some of the principal data required to "instruct intelligent thought on the subject of the coal stoppage."

Moving a Building.—In Pittsburgh, the removal to new sites of several buildings was made necessary by the widening of Second Avenue. Among these, Woodwell Building—a narrow, eight-storey place, 20 ft. wide, 80 ft. long, and over 100 ft. in height—was rolled in less than 24 hours by twelve labourers armed with crowbars and screw-jacks, to a fresh foundation 40 ft. away. From the point of view of "JOURNAL" readers, the most interesting feature attending the task of moving this building was the carrying along intact of the entire gas-equipped heating plant, and over 1200 sq. ft. of reinforced concrete sidewalk surrounding the building. Heavy 1-in. oil-hose was successfully employed to maintain the gas and water services while the building was being moved. The structure, including its stock of hardware supplies, was estimated to weigh about 10 million pounds.

"FIELD'S ANALYSIS" FOR 1920 *

Some Notable Figures from Exceptional Circumstances.

A COPY of the 1920 edition of Field's Analysis has been received; and, as usual, we have found in it many interesting items calling for comment. Before touching upon them, it will not be out of place to say that, however well the per 1000 c.ft. basis has served up to the present time, we are disposed to be dissatisfied with the results obtained thereby now that there has been brought to our minds the promise of a truer basis—one which will introduce quality as well as quantity. However, nothing can be accomplished in the new direction so far as the workings of 1920 in the "Analysis" are concerned; but we are pleased to see from a letter received from Mr. H. E. Ibbs, and published in this week's "JOURNAL," that a change is coming in the very near future. It is understood that the opportunity will be taken to reconstruct the plan of the work with the object of placing the information in a more sequential form, and of removing one or two anomalies that exist at present. It need hardly be said that, apart from the very necessary change that will be required in consequence of the introduction of the therm, it is difficult to see how the present work could be bettered; but probably those responsible for the compiling of the details, like all true workmen, are conscious of various little points where improvements can, with advantage, be effected. Having said this, we will proceed to review the information placed before us by the new issue.

OUTPUT, CAPITAL, AND CALORIFIC VALUE.

The first thing that is noticed, and the one which, by the way, should be always foremost in consideration, is the output of gas. In the total of every group an increase appears; and, with the exception of three of the Provincial Corporations, an increase is shown in the case of every individual undertaking. This is a wonderful state of affairs, and augurs well for the future of our industry. Naturally this larger output of gas, together with the high cost of materials, &c., has necessitated the use of more capital; and additions are noticed in the case of some of the Suburban as well as Provincial Companies. Another interesting and very important piece of information is obtained from the column which shows the calorific value of the gas supplied. It is noted that a figure above 500 B.Th.U. is shown in only four cases of those recorded. Of the four cases, three top the 500 by a very small margin; but the notable exception is that of the South Metropolitan Gas Company, where a figure of no less than 554 B.Th.U. is stated—this being far in advance of the calorific value shown in the case of any other undertaking referred to in the "Analysis."

RISING COSTS—EXTRAORDINARY FIGURES FOR SECONDARY PRODUCTS AND WEAR AND TEAR.

Eloquent of the rising cost during the year is the charge shown per 1000 c.ft. under net gas-rental. An increase of upwards of 3d. appears in the case of the Metropolitan Companies, an amount of nearly 8d. for the Suburban Companies and Provincial Corporations, and 4d. in the case of the Provincial Companies. Edinburgh Corporation has advanced by over 15d., and Dublin by nearly 20d.! Naturally, with the boom in export coke, the receipts for this residual are high. We see the Gas Light and Coke Company have an enhanced figure of 59s. 4d. per ton of coke, as against 37s. 10d.; while Newcastle reached a figure of 72s. 9d., as against 41s. 11d. for the previous year.

With regard to another residual—tar and its products—mention must be made of the extraordinary figure of 10·77d. per gallon obtained by the South Metropolitan Gas Company. It is interesting to note that the receipts for the Metropolitan and Suburban Companies for tar are far in advance of those experienced in the Provinces. With these high figures for residuals, it is not surprising to find the net cost of coal, even allowing for the increase in the gross cost, showing an improvement in one or two groups—that of the Metropolitan Companies being the more pronounced. This does not seem consistent at first sight with our previous remark relating to the charge under net gas-rental; and the cost of the higher prices for gas must be looked for in some other direction than the net cost of coal. It is revealed when we come to the expenditure on manufacturing wear and tear and the charges under distribution, where the increases in cost are very marked, being due, of course, to the putting in hand at last of so much of the necessary work that had to be postponed owing to the war.

SMALL PROPORTION OF PROFIT FOR DIVIDEND.

Coming to the net result of the workings for the year, we again find that a very small proportion of the amount charged for gas was used for paying a dividend to the shareholders in the various companies; and it is noticed in the case of the Suburban and of the Provincial Companies as a whole that the charge for capital is an even lower figure than that experienced in the previous year. It is to be hoped that for the shareholders' sake a very different tale will be told in the "Analysis" next year, and that one of the fruits of the Gas Regulation Act may become evident.

* "Field's Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland for the Year 1920." Compiled by Herbert Edward Ibbs, Accountant to the Gas Light and Coke Company. London: Eden Fisher & Co., Ltd. Price £2 2s.

A WONDERFUL RECORD DAY.

At the end of the work, we find as usual the very interesting collection of facts and figures; the most remarkable item probably being the one showing the increase in the record day of the Gas Light and Coke Company—a figure of 152½ millions having been reached—11 million cubic feet above the previous highest day experienced by this Company. On turning to statistical records showing the output of gas for the whole of the United Kingdom, we find that the figure reached by the Gas Light and Coke Company in its record day is not far short of the average yearly output of all the undertakings.

A COMPARISON WITH THE PRE-WAR YEARS.

If an extract is made of the figures shown in "Field" for 1913, and compared with those given in the present "Analysis," a very interesting statement is presented of the effect upon the industry's finances of the war period through which we have just passed. The following figures refer to the Metropolitan Companies, and should be indicative, more or less, of the position of the majority of the undertakings throughout the kingdom.

Metropolitan Gas Companies.

	1913. Pence per 1000 C.Ft.	1920. Pence per 1000 C.Ft.	Percentage of Inc. or Dec.
Net gas rental	27·70	53·33	92·53 Inc.
Meter, stove, &c., rental and sundries	4·34	5 34	23·04 „
Residuals	11·16	35·55	218 55 „
Total income	43·20	94·22	118·10 „
Coal	15·67	43·55	177·92 „
Manufactory charges	6 93	22·64	226·70 „
Distribution „	6 42	13·03	102·96 „
Management „	1·11	2·56	130·63 „
Other „	3·94	5·40	37·16 „
Total expenses	34 07	87·18	155·88 „
Gross profit	9·13	7·04	22·89 Dec.
	43·20	94·22	118·10 Inc.
Dividend paid	8·44	5·38	36·26 Dec.
Reserve and carry forward	5·87	3·13	46·68 „

We heartily congratulate Mr. Ibbs, and those who have assisted him in the work of preparation, upon the value and interest that the "Analysis" again contains. The times have been extraordinary; and the figures possess the same characteristic. The industry is marching from change to change, until a new normal level and standards will have been reached; and as time advances and the changes are developed and established, the large interest found in the "Analysis" to-day will not abate, but will, if anything, be intensified. There is important history in the figures.

A FORMULA FOR INCREASING GAS PRICES

UNDER THE CHANGED ECONOMIC CONDITIONS IN BELGIUM.

IN the speech of Sir Charles J. Jessel, Bart., at the recent meeting of the Imperial Continental Gas Association, somewhat frequent mention was made of a formula which had been propounded by a Technical Commission appointed by the Belgian Government to consider the question of how to arrive at what would be a fair increase to make in the prices of gas under the new economic conditions. As Sir Charles showed, the formula which resulted from the study of the matter by the Commission was based upon the variable factors of coal and wages. In view of the interest which this matter of price increasing has in current times for all gas suppliers, we have obtained from Mr. R. W. Wilson, the Secretary of the Association, some further information—extracted from the report of the Commission—regarding the formula; and this is given in the present article, together with (at the end) an example by Mr. Wilson of the application of the formula. This, by the way, has been adopted by the Belgian Government; and it is to apply to all cases where no special post-war agreement for compensating the gas undertakings for abnormal increases in the cost of manufacture is, or has been, arrived at between the communal authorities and the gas contractors.

The Commission studied the question as to the extent to which it would be fair to take into account the increased value of the various elements which go to make up the cost price of gas. They came to the conclusion that the increase in the price might be expressed by a formula with two variable factors—viz., coal and wages; these being affected by a coefficient.

The first of these coefficients relates to coal, and takes into account—

(1) The influence of the receipts derived from the sale of bye-products.
(2) The increased cost of maintenance and working.
(3) The additional financial burdens due to the increase in working capital necessary to enable undertakings to be carried on in a normal manner.

The second coefficient relates to wages, and takes into account—

(1) The increased cost of wages and salaries.
(2) The increase in general expenses.

The Commission examined the question of the value which should be attached to these two coefficients; and they concluded that it could be fixed at a uniform figure for all works without risk of any serious error. In 1919, Referees were appointed to examine, in an advisory capacity, the question of the modification of tariffs for gas and electricity concessions in the Province of Hainault; and they drew up a formula with only one variable—viz., coal. At that time a formula of this nature exactly met the existing position, because the increase in the rate of wages had until then been proportionate to the increase in the price of coal. But, at the present time, this proportion no longer exists, as wages have increased to a much greater extent than fuel. It is for this reason that the Commission preferred a formula making separate allowance for the increase in rates of pay in arriving at the addition to be made to the prices of gas. The formula they proposed is as follows:

$$M = 0{\cdot}0024\ (C - 24)\ \textit{plus}\ 0{\cdot}09\ (S - s)$$

C represents the price in Belgian francs per ton of coal of the type chosen as standard. The price is to be understood to refer to coal delivered at the works. [In the report of the Technical Commission, some details were given in regard to the standard coal.]

24 represents the average price in Belgian francs per ton of standard coal delivered at the works for the period from Jan. 1, 1910, to July 1, 1914. This price is based upon statistics.

S represents the current hourly wage of a stoker working eight hours per day. This wage is expressed in francs. By "stoker" is meant a workman who charges coal into retorts, whether such stoking be effected by hand or by mechanical means.

s represents the average hourly wage of a stoker from Jan. 1 to July 31, 1914; the day being assumed to be twelve hours. This figure can easily be arrived at on the basis of statistics kept at each works.

M expresses in francs the increase to be applied to the pre-war tariffs, no matter whether the gas be intended for public lighting, heating, or motive power; gas supplied gratuitously before the war being considered as sold at zero.

In order to apply the formula, it is necessary to ascertain the average values of C and S for a quarter or a half year; these values serving for the calculation of the increase in price to be paid during the following quarter or half year. Thus, for an increase to be applied from July 1 to Dec. 31, 1920, account will be taken of the average value of C and S, arrived at for the period from Jan. 1 to June 30 of the same year.

The formula takes no account of interest and amortization in respect of supplementary financial charges arising from the increased cost of extensions and renewals resulting from contract stipulations. In view of the diversity of such clauses—among which must be included stipulations fixing rent for meters, for consumers' connections and interior installations—the Commission considered that it would be impossible to take these items into account in a general tariff formula. The Commission recommended that an amicable agreement be arrived at in this matter between the contracting parties. Should this be impossible, the modification to be made to these special clauses can be examined separately in each case by the Commission. But in their view it would be well to suspend their application temporarily until a decision has been arrived at in regard thereto.

The "increase" formula is applicable to all gas-works in Belgium, except those which take all, or part, of the gas they distribute from coke-ovens. The determination of the increased prices for each of the works falling under this category constitutes a special case, which must be studied separately by the Technical Commission.

The gas prices arrived at by the application of the formula apply to gas of good quality such as can be manufactured with the coal at present supplied to gas-works.

The majority of the contracts concluded before the war contain stipulations relating to the illuminating power of the gas. As a matter of fact, since the use of incandescent burners has become general, there is no object in these prescriptions. The Commission advocated that they should be considered as suppressed, and be replaced by stipulations relating to the heating power of the gas. The heating power determined, in practice, by means of calorimeters of the best-known makes—the Commission instance Junkers and Boys—is the gross calorific value. It should be on an average 4250 calories (with a margin of 3 p.ct. above or below) per cubic metre of gas reduced to a temperature of 0° C., and with a barometric pressure of 760 mm. This is lower than the power stipulated in some contracts concluded in Belgium before the war; but it should be noted that experience has shown, both during the war and in 1919, that the calorific power of 4000 to 4500 calories is the most suitable for the gas apparatus generally used by Belgian consumers. The effect of maintaining the heating power at 5000 calories would be, the

Commission point out, to cause a further increase in the price of gas, owing to the necessity of using very expensive foreign coal, or of carbonizing less completely a larger quantity of Belgian coal, which would result in the quantity of fuel available for industrial purposes, private consumption, and export, being reduced. This additional expense would therefore be incurred to no purpose whatever; and it would clearly prejudice the general interests of the country to necessitate such expense in present circumstances.

As regards the pressure at which gas should be supplied to the consumers, although no general figures can be given on this point, the Commission considered that it should be as constant as possible, not only at the times of usual consumption, but also from day to day.

EXAMPLE OF THE APPLICATION OF THE FORMULA.

$$M = 0{\cdot}0024\,(C - 24)\ \textit{plus}\ 0{\cdot}09\,(S - s)$$

Assuming coal to cost frs. 120.51 per ton, as against frs. 24 before the war, and a stoker's hourly wage to be frs. 2.474, as against frs. 0.428.

$$M = 0{\cdot}0024\,(120{\cdot}51 - 24)\ \textit{plus}\ 0{\cdot}09\,(2{\cdot}474 - 0{\cdot}428) = 41{\cdot}5.$$

That is an increase of 41½ centimes per cubic metre on the gas prices of 1914.

PERSONAL.

The Gas Committee of the Edinburgh Town Council have decided to appoint Mr. JAMES JAMIESON, Assistant Gas Engineer at Greenock, Assistant to Mr. H. H. Gracie, the Edinburgh Gas Manager. The salary attached to the post is £500 a year.

At a meeting of the Council of the Institute of Chartered Accountants of England and Wales, held last Wednesday, Mr. WILLIAM CASH, F.C.A., was elected President, and Mr. ALFRED COTTON HARPER, F.C.A., was elected Vice-President, for the ensuing year.

Mr. H. TALBOT, B.Sc., A.R.C.S., has been appointed General Manager of the Welsbach Light Company, Ltd. Mr. Talbot is Hon. Secretary of the Chemical Engineering Group of the Society of Chemical Industry.

Reference was made at the meeting of the Lancaster Town Council on the 1st inst. to the departure of Mr. J. T. HAYNES, Works Superintendent of the Corporation gas undertaking, on his appointment as Assistant Manager at Bolton. Councillor Till (Chairman of the Committee) paid a high tribute to the services of Mr. Haynes. Mr. George Dixon (the Gas Engineer), in a letter to the Committee, stated: "I would like to express my personal appreciation of the work done by Mr. Haynes for Lancaster. . . . He has only to-day (May 31) brought his work here to a successful conclusion. I am proud to have had Mr. Haynes as my Assistant."

OBITUARY.

Mr. J. F. SANDERS, one of the oldest, as well as one of the most respected, inhabitants of Ilminster, who has just died, had been a Director for 37 years, and Chairman for nearly nine years, of the Ilminster Gas Light, Coal, and Coke Company, Ltd. He was in his 81st year.

Woolgar's Baffler for Geyser Flues.

Many people have adopted, during the past few years, with perfect success, a device for geyser flues, gas-burners, &c., known as Woolgar's patent baffler. This is a simple arrangement, with a total absence of complicated parts, for entirely excluding from the bathroom all burnt gases, &c., and at the same time rendering a down-draught an impossibility. It is the result of many years of experiments, and is guaranteed to accomplish everything that is claimed for it. In his patent specification, Mr. S. M. Woolgar says that the baffler can be made to any size required in galvanized iron or other suitable metal. It comprises a bayonet or like suitable joint for easy detachability for cleaning purposes, an upper inner cone with a small hole and tube to obtain an upward air current, and a bottom inverted cone larger than the upper outer cone, to catch the condensation from the upper part of the baffler—this cone being fixed to the bottom flue-tube which projects through to above the level of the edge of the cone, and contains two small holes to allow the condensed water to escape from the cone into the emptying chambers of the gas appliances. An upper outer cone is fixed to the upper flue tube. The inner cone and the upper and lower parts of the baffler are secured together by means of metal straps. The baffler is so arranged as to prevent gas being blown out at the lowest point of consumption. The Brighton and Hove Gas Company alone have had supplied to them over 400 of the bafflers—which evidence of their utility should be sufficient to ensure for them a trial in districts where they may not yet have been tested. It should be mentioned that the selling agency and manufacture of the baffler are being taken up by Messrs. Bostel Bros., Ltd., of Nos. 18 and 19, Duke Street, Brighton.

ELECTRICITY SUPPLY MEMORANDA.

SELF-INTEREST has a way of limiting the angle of observation. It is a common human failing; and perhaps few of us can claim not to have fallen a victim to the assertiveness of self-interest at some time or other. A "Manufacturer" recently wrote to the "Leicester Mail," protesting against the restrictions that have been placed upon electricity, while gas (he says) has been exempted. He states that many progressive manufacturing firms have discarded gas, and replaced it by electricity. Why these firms and their workpeople should be penalized by the change, when both gas and electricity are supplied by the same authority, he does not know, We are not quite sure what "Manufacturer" is driving at—whether it is something peculiar to Leicester. But, as a matter of fact, the same restrictions that have emanated from the Board of Trade or the Mines Department apply to gas as well as to electricity, so far as manufacture is concerned. Nevertheless, if the person complaining knows anything about the production of gas and electricity, he will know that there is greater elasticity in gas manufacture than in electricity generation. If, therefore, the Leicester Gas Department are in the fortunate position of being able to do better than the Electricity Department for Leicester manufacturers then, in the name of common sense and the best interests of the borough, it is surely their duty to do so. Outside industry, gas has a larger, more important, and more diverse application in the homes of the people than electricity; and, in these times of stress for fuel, there is no agency upon which so much responsibility rests to relieve the fuel discomforts of the people, and to help to maintain health, than the gas undertaking of each town. As a fuel, gas ranks next to coal in everyday use; electricity only plays upon the boundaries of fuel requirement. These are times when the best that can be done for the majority is the correct policy; and when the best is being done, it is not very becoming of anyone to complain. "Manufacturer," in changing from gas to electricity, took the risks of doing so; and he must surely abide by the consequences.

Restrictions on Electricity; Exemptions for Gas.

Future Fuel Storage.

"Oil has saved the situation for several electric power stations and industries," writes "Meteor" in the "Electrical Times." He might have added, so has coke. We have spoken about this fuel question on several occasions recently. "Meteor" thinks that in the end it may not be a bad thing that electrical engineers have had the experience and object lesson. He suggests that it will now be the duty of the engineer to consider whether he can best store in oil, in coal, or in both. Why not have another string to the bow, and add coke, seeing that it is being used with high efficiency (where proper application is made) at several stations? Coke is constantly being produced at the neighbouring gas-works; and it has virtues for boiler-firing, particularly with coal under the Nicol stratified or sandwich plan. When boilers are equipped in this way, the terrors of miner's strikes or of strikes of men who handle imported oil, would be largely minimized, as gas-works are bound for their own protection to have large coal storage. However, "Meteor" warns station engineers that they will fail in their duty in future if they do not arm their stations with the means for withstanding a three-months' siege—preferably four or five months. There must be "intelligent anticipation." Our friend says nothing about the capital provision for the storage, the capital lying idle in the forms of coal or oil in store and not earning anything, insurance, and depreciation. These are matters the electrical engineer has to consider as well as the preparation for a stoppage of supplies. At the same time, continuity of service is of primary importance; and its assurance must naturally cost a certain amount of money. While mentioning fuel oil, it is noticed that the Dundee Electricity Committee are not sufficiently enamoured of it to induce them to incur the cost of conversion, though there are so many precedents. A report by the engineer on the subject informed them that at present prices, and estimating that 70 tons of oil could do the work of 100 tons of coal, the cost would be respectively £490 and £300. The cost of fitting oil-burners, it was stated, would be between £2000 and £2500. The Committee decided not to proceed in the matter, as considerable expense, which would have to be met by higher charges, had already been occasioned by the coal dispute.

Disinclination.

It was seen by a paragraph in last week's issue [p. 477] that the Lower Severn Joint Authority scheme has been abandoned by the Organizing Committee, on the ground that it is impossible to do anything of a collective character in the south-west area. Refusal to collaborate and indifference not only on the part of local authorities, but those responsible for local industries, are largely to blame for this condition of things. The manufacturers whom these generating schemes are, according to theory (how it would work-out in practice nobody knows), intended to serve foremost, show as little concern in them as any "man in the street." Some of the councils who originally took an interest in the preliminary work of organizing Joint Electricity Authorities have withdrawn, are grumbling over the

payment of their share of the expenses, and are declining to do any more in the same way. The Bootle Town Council and the Millom District Council are the latest objectors in connection with the North Lancashire provisional scheme. Both authorities have refused to pay accounts rendered in connection with it.

Speculation and the New Schemes.

A cold douche has been applied to the editorial article in the "Electrical Review" which formed the subject of a paragraph in last week's "Memoranda." Our esteemed contemporary, it will be remembered, was out to rend to pieces those who thought the Electricity Supply Bill (No. 2) should be destroyed; and, while it considered company management of large generating schemes would be better than joint authority, it attempted to administer a thrashing to those hypocritical companies who spoke of the speculation involved and the danger to the rates, while themselves desiring to get hold of the work of super-generation. The big generation schemes have within them all the elements of present costs, and with hybrid authorities directing them, for causing the costs of electricity to be dearer rather than cheaper; so that the speculation about them is very pronounced. A communicated article has appeared in our contemporary courteously criticizing the editorial, and advancing proof that the pen that wrote it had trespassed beyond all the available evidence. As we have before pointed out, no one can possibly assert that these wonderful reorganizations and concentrations of generation are going to do anything to cheapen electricity supply, compared with the ordinary evolution of the existing generating stations. There is not a shred of testimony that they will produce the expected benefits; there is nothing but assumption. Even the report of the Board of Trade Committee in 1918 was composed largely of opinions, with little or no evidence in support, and the series of recommendations by the Committee were mainly based upon these opinions. But there seems to have been a growing doubt since as to whether the super-stations would be able to supply as cheaply as the existing stations. The contributor of the article shows the uncertainty that obtains in the official mind, and in the minds of other people.

The Evidence and a Suggestion.

In the Electricity Supply Bill promoted in the session of 1919, it was provided that, when a station was taken over (except by agreement), the district authority should be under an obligation to supply electrical energy to the undertakers at a price not greater than that at which it could have been generated by the existing station. This clause went among others when the Bill was curtailed in order to get parts of it passed into law that session. By the present (No. 2) Bill, it is proposed to enact that the prices charged shall be so fixed by the authority that over a term of years, to be approved by the Commissioners, the receipts on income account shall be sufficient to cover expenditure (including interest and sinking-fund charges), with such margin as the Commissioners may allow. The change between the 1919 Bill and that for 1921 implies doubt. Should it be found that electricity cannot be supplied as cheaply as the scrapped stations could have generated at, then the price will have to be raised to a figure that will enable the Joint Authority to make ends meet. The contributor of the article is of opinion the capital charges on the super-stations will be six times more than they were on the pre-war erected stations; and so he thinks he has good ground for joining issue with the editorial statement that electricity supply has ceased to be speculative. No one can say whether or not, or if so to what amount, there will be any charges upon the rates; but this we do know, that the Joint Electricity Authorities, who will have the spending of large sums of money, will not be directly answerable to the ratepayers. The contributor suggests the inclusion in the Bill of two additional clauses to the effect that: (1) The rates shall on no account be charged with any deficit due to the operations of a Joint Electricity Authority; and (2) that no station of an existing authorized undertaker shall be prohibited from continuing to develop by putting-down additional plant, unless a supply can be obtained at a lower cost than it can be generated at if the additional plant is installed. Would the "Review," with all its staunch belief in electricity supply not being speculative under the schemes, care to run the risk of having these suggested clauses inserted? We question whether it would. But it could well refuse, if the day of speculation in electricity supply has passed away.

Peculiar Conditions in the West Riding.

The Electricity Commissioners have been holding their inquiry into the schemes which have been put forward for the Aire and Calder (West Riding) district. This is an important area—an area packed with industrial undertakings; but unfortunately for super-station enterprises and plans, it is not one of the best districts for the creation and development of this particular form of station, owing to inadequate water condensing resources. The district includes Leeds, Bradford, Wakefield, Barnsley, Dewsbury, Halifax, Huddersfield, Batley, Brighouse, Keighley, Morley, Ossett, Pontefract, Pudsey, Todmorden, and a host of smaller places. The importance of the area needs no further proof. For the district, three schemes have been proposed—one by the Leeds Corporation, one by the Yorkshire Electric Power Company, and one by a conference of local authorities at the head of which stands Bradford. The bulk of the municipalities have a desire to exclude private enterprise from the scheme; but the Leeds Corporation are not so obsessed by municipalization that they think private enterprise in such a matter ought not to have a place on the earth. The Yorkshire Company are receiving a large measure of support from the industrial element in the area—in other words private enterprise is associating itself with private enterprise; and the preference for doing this is growing. However, we cannot here go into the respective virtues of the three schemes; but there is one interesting technical point which came out in the opening on the Leeds scheme, and which may be quoted: "One peculiar feature of the electrical position in the area was that by 1935 there would be remarkably little difference in the situation, financial and electrical, from what prevailed now, whether the Leeds scheme or any other scheme, or no scheme, were adopted and normal independent evolution took place. It was not a practical proposition—owing to the difficulty of finding adequate cooling resources within convenient distance—to contemplate the erection of one super-station. Whatever scheme was adopted, there were going to be only moderate-sized stations, and these stations would probably be three in number." Natural causes sometimes defeat the best-laid schemes. But above all it is a notable prediction that by 1935 there will in the area be remarkably little difference in the situation, financial and electrical.

High Intrinsic Brilliancy and Virulent Rays.

We are not very much interested in artificial illumination for kinematography; but we are in the relative intrinsic brilliancy of lights, and their spectroscopic composition. Some of the electrical papers have consistently derided the points made as to the eye injury caused by intrinsic brilliancy and the ultra-violet and infra-red rays of the electric light; while others have urged the use of diffusing and protecting glassware with a view to minimizing the trouble. In a paper by Mr. J. C. Elvey before the Illuminating Engineering Society, he shows the high intrinsic brilliancy of various forms of electric lamps. The candle power of gasfilled tungsten lamps is given as 2200 c.p. per square inch; of the flame arc 5000 c.p.; and of the open arc, 10,000 to 50,000 c.p. Mr. Elvey records the general impression that the main cause of the eyesight troubles in studios is the light sources of great intrinsic brilliancy; but he says it is possible that the strong ultra-violet component in some lights may accentuate a tendency to inflammation of the eyes. Inflammation or scorching of the skin which accompanies eye irritation in some cases is also a well-known result of excessive exposure to ultra-violet light. It seems clear, however, that the danger of injury occurs mainly when images of great concentrated brightness are formed on the retina of the eye. The author went on to refer to reports of artistes suffering from eyesight troubles which have arisen from exposure to powerful illuminants. From the artistic and humane points of view, he urges that action should be taken to protect them from these effects. The matter was incidentally referred to during the discussion. In a written communication by Prof. W. M. Bayliss, he states that probably ultra-violet light is the most dangerous to the eye; while the constant brilliancy of the visible light is more or less cut-off by contraction of the iris, provided that changes of the position of the actor do not expose him to intense glare. Screens of appropriate glass are recommended to cut-off the virulent rays. Mr. W. E. Bush also submits that by the use of screens the extra cost of current required would be well worth while, if the risk of visional damage could be definitely avoided by this means. That there is injury—and serious injury—is admitted. That it is due to high intrinsic brilliancy and the composition of the lights, there can be no manner of doubt; but the best means of correction have not yet been sufficiently determined.

"S.B.G.I." Meeting and Dinner Postponed.—Owing to the continuation of the coal strike, the annual meeting and the dinner of the Society of British Gas Industries, originally fixed for Wednesday of next week, have been postponed to the autumn. We learn from the Secretary (Mr. Arthur L. Griffiths) that the view of the President, Sir Arthur Duckham, K.C.B., is that he believes this decision will meet with the general approval of the members, in view of the critical industrial situation. We are certain he is right.

Coke Cooling and Steam Raising.—An interesting account of a new coke-cooling plant installed by Messrs. Sulzer, in the Schlieren gas-works of Zürich, is, says "Engineering," given in the "Schweizerische Bauzeitung." The object of the innovation is to cool the hot coke, coming from the retorts, without quenching it in water, and to utilize the heat of the coke for generating steam. The hot coke is discharged into a kind of shaft furnace lined with firebricks, and separated by a firebrick wall from a vertical water-tube boiler, the whole forming an enclosed pit, which is accessible at the top and bottom. A fan, mounted near the bottom of the pit, works the hot gas of the coke upward through the coke and through a flue connecting the two compartments down the boiler shaft in which the feed water is circulating. Apart from leakages, air is only admitted during the charging and emptying of the furnace; the oxygen present in the shaft is soon consumed in oxidizing the CO to CO_2; so that after a while the hot gas circulating will consist essentially of carbon dioxide and nitrogen.

ARTIFICIAL LIGHTING OF GOLF LINKS AND TENNIS COURTS.

Summer time is here, and the daylight period that can be given to outdoor recreation has been extended; but it is in winter time, when there is less daylight and the climatic conditions are not uniformly so favourable for outdoor exercises of the popular order, that the votaries of games and sports would like to have more time—and more convenient time—for relaxation. Mr. J. S. Dow has been considering the matter of how artificial light can be applied to this end; and in introducing a discussion on the subject at the final meeting of the Illuminating Engineering Society on Tuesday of last week, he showed that his study of the matter has been extensive, and so has provided a starting place from which there can be development. He discussed conditions and colour of environment, and the best modes of producing the most efficient effects in play by the aid of artificial light. There seems hardly a game outdoors that cannot be carried on by artificial light, and several that can be continued in winter in buildings specially designed for the purpose; and ordinary indoor games would be all the better for more appropriate arrangements of lighting, which was a subject he also discussed.

Reference was made by Mr. Dow, among many other matters, to the lighting of golf links, which, of course, means a very large area to light. There are natural obstacles—trees, &c.—on some links which would be apt to obstruct light. On the other hand, players move deliberately, and so there is less objection to the erection of posts, which might be occasionally struck by the ball, but might be regarded as "natural hazards." The aim would presumably be to provide moderately even illumination by well-screened lights over the fairway, and higher local illumination over the putting greens, bunkers, &c. Mr. Dow understands that the lighting of a complete golf links has been seriously considered in the United States. Mr. T. J. Little has described the lighting, by incandescent gas, of a small area (40 ft. by 80 ft.) at New Jersey used as a putting green. Four lamps burning 18 to 20 c.ft. of gas per hour each were used; and the illumination on the green was 2½ foot-candles. Holes were painted white inside so as to be easily seen. It was stated that a ball on the green was easily visible 200 ft. away; and sufficient light was allowed to scatter over the ground in the vicinity of the green to permit of mashie shots from a distance of 100 ft. The cost of the lighting was only 7½ c. (approximately 4d.) per hour. Thus the use of artificial light to enable golfers to practise putting seems quite feasible. It also appears that, while it is admittedly difficult to illuminate adequately an entire cricket ground, artificial light might well be employed for the local illumination of practice pitches surrounded by nets.

Lawn tennis offers great possibilities for artificial lighting with a view to extending the hours of play. The lighting of courts in the open presents some difficulties, as one cannot obtain assistance from surrounding wall-surfaces. Such lighting has, however, been attempted. Data regarding the illumination by incandescent gas of some outdoor courts at New Jersey have been furnished by Mr. Little. Sixteen lamps, consuming 288 c.ft. of gas per hour, were used per court; the cost working out to about 1s. per court. If several courts, side by side, are lighted, the number of lamps necessary and the expense are naturally reduced. Posts with extending arms were mounted all round the courts; all such posts, except two on either side of the net, being well removed from the actual area of play. The results are said to have been satisfactory. It is evident that if balls are lobbed high, they tend to pass out of the illuminated zone, and may be temporarily lost sight of. This difficulty, presumably, must always be met when lighting unconfined outdoor courts, but might be minimized by allowing a certain amount of diffused light to pass upwards.

The well-known covered courts at Dulwich afford an interesting example of what can be done with artificial lighting indoors. Through the courtesy of Mr. Percy Rootham, the Secretary of the club, Mr. Dow obtained full particulars of the lighting conditions shortly before the outbreak of war; and he understands that the method has proved so satisfactory that it has since been retained in substantially the same state. The lighting is effected by 1500-candle power high-pressure gas-lamps, at a height of 25 ft. Originally these lamps were attached to the girders at intervals immediately above the courts, but afterwards it was found preferable to equip them with special shades and distribute them at the sides so as to be quite out of the range of vision of the players. Overhead shielded lights have, however, been retained at the extreme back of the courts so as to enable the figure of the server to be clearly seen. These courts utilize a blackened wood surface; and there is a clear height of travel of 35 ft. for the balls. The walls round the court are also painted a dead-black, so as to show-up the white balls and the white lines of the court in strong relief. Measurements showed that the illumination on the floor of the courts was 4 to 5 foot-candles, and that the contrast between white balls and black court surface was about 10:1. The writer was informed that red balls had been tried, but were found less satisfactory; the contrast in this case being only 5:1. The cost of lighting at these courts in pre-war days was stated to approximate 6d. per hour per court.

The design of the above courts was due to Mr. H. M. Rootham, who also furnished the writer with particulars of his design, on similar lines, of an electric lighted covered tennis court in Parliament Street, Liverpool. In this case eight 1000-candle power tungsten lamps at a height of 28 ft. were spaced all round the courts, and two special 200-candle power lamps in conical shades placed over the back lines so as to illuminate the server. The consumption of electricity worked out to 1·5 watts per square foot. The cost of the lighting was estimated at about 2s. 6d. per court per hour.

ILLUMINATING ENGINEERING SOCIETY.

Co-Operation and Committees on Gas Lighting Appliances and Photometry.

The Annual Meeting was held on Tuesday of last week, at the Royal Society of Arts. The President (Mr. J. Herbert Parsons, C.B.E., F.R.S.) was in the chair.

The Hon. Secretary (Mr. L. Gaster) gave an account of the work of the Society during the session. It opened by announcing that the Society had completely resumed its normal activities. Stress was particularly laid upon the fact that various problems upon which the Society are engaged involve, and are receiving, the co-operation of ophthalmologists and physiologists. In view of this, great pleasure has been given the members by the acceptance of the presidency by Mr. Parsons, in succession to that old friend of the Society, Mr. A. P. Trotter, who has done so much in contributing to our knowledge of the measurement and application of artificial light. Co-operation, as already said, is a strong point with the Society; and the meetings of the session have aptly illustrated the benefits of co-operation with other bodies in dealing with matters of common interest. Comment was made upon the proceedings at meetings; and dealing with the work of the various Committees (of which there are several), it was recalled that prior to last session a Committee was formed to report on progress in electric lamps and lighting appliances, and to keep the Society informed of developments in this field. A similar Committee to deal with gas-lamps and lighting appliances has now been formed, with the co-operation of the Society of British Gas Industries. The present members are Mr. J. Bridger (Chairman), Mr. F. J. Gould, Mr. Geo. Hands, Mr. W. Mattock, Mr. F. C. Tilley (Secretary). The Committee presented a report at the opening meeting of the present session; and it is hoped that its formation will be useful in establishing the best methods of utilizing gas for lighting, and in keeping the Society informed of the latest developments. In view of the growing demand for measurements of illumination in various fields of illuminating engineering—notably in connection with streets, factories, &c.—it was felt that the time was ripe for the formation of a Standing Committee on Photometry and Allied Subjects, to deal with the various outstanding problems. Such a Committee has accordingly been formed, and at present includes Mr. A. Blok, Mr. J. G. Clark, Mr. W. C. Clinton, Mr. J. S. Dow, Mr. K. Edgcumbe, Mr. L. Gaster (Secretary), Mr. Haydn T. Harrison, Mr. W. J. Liberty, Prof. J. T. M'Gregor Morris (Chairman), Mr. A. Stokes, and Mr. A. P. Trotter. The Committee are already undertaking researches into the accuracy of photometric measurements of various kinds, and have also accepted an invitation to co-operate with the Advisory Committee on Smoke Abatement attached to the Meteorological Office in regard to the absorption of light owing to suspended impurities found to be in the atmosphere. Reverting to co-operation, it was pointed out that the arrangement by which the Presidents of kindred Associations become, during their tenure of office, members of Council of the Illuminating Engineering Society now applies to the following bodies, whose co-operation has been of great value: The Illuminating Engineering Society in the United States, the Illuminating Engineering Society in Japan, the Institution of Gas Engineers, the Institution of Electrical Engineers, the Council of British Ophthalmologists, the Ophthalmological Society, the Physiological Society, the Electrical Contractors' Association, the Society of British Gas Industries, and the Association of Railway Electrical and Telegraph Engineers. The London "Safety First" Council and the British "Industrial Safety First" Association have been continuing their valuable work; and the fact of the Society being represented on both bodies has enabled the study of lighting in relation to health, safety, and efficiency to be actively pursued. It was also mentioned that the National Illumination Committee have now resumed regular meetings and have been engaged in the preparation of a list of definitions of the chief terms used in illuminating engineering. A gratifying indication of the restoration of more normal conditions is the recommencement of international co-operation in illuminating engineering. It has been arranged that a session of the International Illumination Commission shall be held in Paris from July 4 to 9. At the various conferences that have been held of late, industrial lighting has been a prominent topic; and at forthcoming ones it will also take an important place—more particularly seeing that the Departmental (Home Office) Committee on Lighting in Factories and Workshops have resumed their investigations. In conclusion, there was mention of the increase of the revenue of the Society through the new arrangement whereby two classes of members—members and associates—are now recognized. Still the revenue is not sufficient to enable the expansion of the work to the extent of which the Society is capable.

Mr. A. Cunnington moved the adoption of the statement Mr. Gaster had made on behalf of the Council. He described it as

a "live" report; and it showed how very active the Society had been during the session. He emphasized two points—the extraordinary wideness of the sphere covered by the Society, which was due to the ramifications of the branch of illuminating engineering; and the other was the splendid system of co-operating with many other societies on the complex questions involved in illuminating engineering, and upon which it was necessary to have the views of experts. He regarded the Society as a pioneer in respect of technical co-operation. He referred also to the time devoted to their work by members of the Committees, and to the valuable service that issued from their labours.

The motion was seconded and unanimously passed.

On the proposition of the PRESIDENT, a hearty vote of thanks was passed to the Council of the Society of Arts for their courtesy in allowing the Society the use of the lecture theatre and their rooms.

THE CASE FOR COMPLETE GASIFICATION.

By W. D. WILCOX, President of the Idaho Falls Gas Company.

[From the "Gas Record."]

The progress of the gas world towards the acceptance of a mixed coal and blue water gas as the product which, everything considered, most nearly meets the demand for an economical production of heat units in a gas suitable for general distribution, is evidenced in a paper by Mr. R. B. Harper, of the People's Gas Light and Coke Company, which appeared in the "Journal of the Western Society of Engineers." [This paper was noticed in the "JOURNAL" for March 2, p. 533.] Mr. Harper, after reviewing the history of the gas industry and the present situation, expresses the opinion that the gas of the future will be a mixed coal and blue water gas. "Such a gas of the future would permit the economical utilization of coal and the maximum production of gas therefrom on the basis of gas-making material costs. The city gas consisting of the blue-water-coke-oven-gas mixture should be very stable in quality, burn well, and, when consumed in burners properly adjusted or set for its use, should give good service to the consumers."

While the writer agrees fully with Mr. Harper as to the suitability of such a gas for use in the various forms of appliances now installed, and in the opinion that it offers the best means of obtaining economy in material costs, he does not believe the method of production suggested—that of carbonization of coal in bye-product ovens and gasification of the coke produced in independent water-gas generators, inferentially of the existing type—is by any means the most efficient possible. This method has the advantage, not urged by Mr. Harper, that a portion of the coke can be sold quite generally at a price much greater than the cost of the original coal, and that by reducing the proportion of water gas in the admixture the heat value of the gas per cubic foot will be considerably increased, thus reducing the cost of distributing a unit quantity of heat and diminishing the demand made upon the storage and distribution system. It follows from the existence of coal-gas plant and water-gas sets in physically usable condition, that the sending-out of a combined gas will often precede the installation of a possibly more efficient type of new generating plant, and that such generating units will be built first by new undertakings and by gas companies who find it necessary to increase their generating capacities. But there are believed to be such economies in the complete gasification of coal in one operation as to justify fully the displacement of horizontal retorts and Lowe type water-gas sets.

WHAT HAPPENS IN GAS MANUFACTURE.

Let us first consider what takes place where the production of coal gas and blue water gas is carried out in separate units. After a period of time amounting in the case of the bye-product oven to fifteen hours or more (during which nearly half the coal gas given off has been burned to heat the ovens, or from 300 lbs. to 400 lbs. of solid fuel consumed in a producer bench furnace), the coke residue is discharged, quenched, and conveyed to storage. The sensible heat in the coke, amounting, at the temperature finally attained, to some 900,000 B.Th.U. per ton, is lost. The items of expense represented by the wages of labour, the provision of quenching water, and the investment and operating costs of the mechanical aids to coke handling, are of substantial amount. When the coke is later charged into a generator, about 100 lbs. in each ton must be consumed in blasting to bring it to the temperature at which it was withdrawn from the oven. In the blasting of a water-gas generator much heat is carried away, both as sensible heat in the blast gases and as potential heat in the form of carbon monoxide. It is impossible to avoid a substantial production of this gas. In bringing the coke to a temperature at which the oxygen released from the water molecule will unite with the adjacent carbon as monoxide rather than dioxide, it necessarily follows that, particularly in the later period of the blast, the combustion will be predominantly to monoxide. In the production of oil-enriched water-gas, this escaping heat is usefully employed to gasify the oil; but where a straight blue water gas is generated, the heat is lost, except the carburettor and superheater be cut out and a waste-heat boiler installed.

We have in the gas-producer a method of completely gasifying coal—in some forms, with production of tar and ammonia as bye-products; in others, with a very nearly complete gasification of the tar. In all properly-constructed producers operated under favourable conditions, there is a very good thermal efficiency. It is readily possible to obtain in the gas 90 p.ct. of the heat units in the original fuel.

INERTS AN OBSTACLE IN PRODUCER GAS.

The handicap of the producer process is that the gas contains from 50 to 65 p.ct. of inerts, chiefly nitrogen. This not only greatly increases the volume to be stored and distributed for a given fuel value delivered, but reduces the flame-temperature, and, by the increase in the heat carried away by the products of combustion, diminishes the proportion which can be imparted to the material which it is desired to heat. If pure oxygen were obtainable at a sufficiently low cost of production, the heat generated by its union with carbon to form carbon monoxide used to break-up steam into hydrogen and oxygen, and the sensible heat in the gaseous product employed first to distil off the volatiles from bituminous coal in the upper levels of a producer and later to make steam, we should obtain from 100 lbs. of coke (90 p.ct. carbon) 3750 c.ft. of a gas about 75 p.ct. carbon monoxide, and 25 p.ct. hydrogen. This gas is assumed to leave the generating zone at a temperature of 2000° Fahr.; but no allowance has been made for heat losses through the walls of the generator, and combustion of the coke is assumed to be complete. A gas coal with 30 p.ct. combustible volatiles, 7½ p.ct. moisture, combined oxygen, sulphur, and nitrogen, 56¼ p.ct. fixed carbon, and 6¼ p.ct. ash, will require 160 lbs. to produce the 100 lbs. of coke assumed above. From its distillation 1000 c.ft. of a 600 B.Th.U. gas should result. The entire product would be 4750 c.ft. of gas having a heat value of 382·8 B.Th.U. per cubic foot. A ton of coal would produce 59,375 c.ft.

There will be a considerable recovery of tar; and with heat losses efficiently minimized, the sensible heat in the conserved gas should make steam enough to support the water-gas reaction in the producer. Forms of gas producers exist which could be so operated as to completely gasify the tar, in which event substantially the total heat value of the coal as disclosed by a calorimetric test, less only the heat escaping through the generator walls and from the gas beyond the waste-heat boiler, would remain in the gas. The commercial success of such a method requires the production of oxygen at a lower cost than is as yet generally possible. Recent estimates made public show that economy in the production of oxygen requires operation on so large a scale, and with such a large investment in plant, as to limit consideration of such a method to communities having a population of about 500,000, and to eliminate a great majority of gas undertakings.

COMPLETE GASIFICATION.

Complete gasification in one operation can be obtained, with a substantial elimination of nitrogen, by alternate blasting and water-gas generation in a unit which is best described as a retort generator. This consists of a vertical retort superimposed upon, and discharging freely into, a water-gas generator. The retort is surrounded by a heating chamber, into which the blast gases from the generator are made to pass, and in which they are fully consumed by the introduction of secondary air. Bituminous coal charged into the retort at the top passes down through the retort by gravity at a rate determined by the consumption of generator fuel. It gives up its volatiles during the passage, in part as a result of heat passing in through the retort walls, and in part from the heat imparted to it by the upward passage in contact with it of the hot water gas produced in the generator during the run, and enters the generator. The generating units of this type best known and coming rapidly into use, at least in Great Britain, are the Tully and the Strache.

TULLY AND STRACHE PROCESSES.

Dr. Strache states that, where water gas at 800° C. (1472° Fahr.) is passed into a retort 1 metre in diameter at the base, carbonization is effected in a period of two hours. As the external heat can hardly pass to any appreciable extent through the 19 inches from the inner surface of the walls to the centre of the coal body during this period, it follows that most of the heat which effects carbonization is supplied by the water gas. It is believed by the writer that, with a retort of relatively large diameter and reduced in height, the distillation results will approach those secured in low-temperature distillation; that the more refractory volatiles which yield hydrogen chiefly in the later hours of high temperature carbonization will remain in the coke as it passes into the generator; and that only a small portion of the heat in the blast gases will be absorbed, so that their further use to make steam or to preheat the air-blast will be found profitable. So far as is indicated by the published drawings, the retort portion of the Tully plant is of greater height than the Strache, and presents a larger surface to the blast gases, and provides for a longer period of heating within the retort, so that the volume of distinctively coal gas generated is probably larger.

Little information is as yet available as to the quantities of tar and ammonia bye-products. The conditions of operation seem to be favourable to a substantial recovery of each. In the Tully plants as first operated, the tar was injected into the upper level of the generator, and quite efficiently converted into gas—the refractory portion being filtered-out by the coal and burned in the blast.

It is a matter of possible interest that the retort generator appears to be an American invention. In a period of premature enthusiasm over the commercial possibilities of fuel gas—premature not only because of the relative lack of development in gas-

burning appliances and fuel uses of gas, but because the low cost of gas oil at the time made possible the production of heat value in gas by the Lowe process about as cheaply as through the complete gasification of coal—several designs of generating unit substantially identical with the Tully were developed in the States. Walton Clark went further, and obtained the grant of a patent upon a twin combined gas machine consisting of two inclined retorts discharging into corresponding generators so connected that, with equal periods of blasting and gas generation, there would be a continuous supply of hot blast gases to the flues surrounding the retorts, and the continuous production of a mixed coal and water gas. This period dates so far back in point of time that the existence of these designs has been generally forgotten, and the patents obtained have expired. The field is clear for the construction of similar plants, and for such improvements by a new group of inventors as progress in the art or operative experience may make possible. Most of the retort generators now in operation in Great Britain are auxiliary to coal-gas plant. They are used to bring down the B.Th.U. of the coal gas to a heat value found to be preferable, and to increase the make of gas from a given quantity of coal. The output falls short of the maximum because of the fact that they are not operated continuously.

After quoting from the paper read by Mr. Henry Rule before the Eastern District Section of the Scottish Junior Gas Association, as given in the "JOURNAL" for Dec. 22 last, p. 704, Mr. Wilcox proceeds: Apparatus for the complete gasification of coal can be efficiently operated in units varying in capacity over a considerable range. Hence it is suited to the requirements of either small or large communities, or as an auxiliary to existing coal-gas plant. Its development should make it possible to supply with profit many communities now denied the convenience of gas. Where used as an auxiliary to coal-gas benches, greater flexibility is secured. Since bituminous coal preferably of a non-coking or imperfectly coking quality is the gas-making material used, there is a wider range in the purchase of coal. It becomes possible to sell all the coke from the benches. Since the proportions of straight coal and combined gas sent out are readily controlled, it is possible to work closely to the standard selected, and to supply gas of a heat value anywhere from 400 to 500 B.Th.U. All these are factors in the situation which must appeal strongly to the gas plant manager at this time.

CAUSES OF STICKING CHARGES IN INTERMITTENT VERTICAL RETORTS.

Methods adopted for dealing with sticking charges in intermittent vertical retorts are explained in the "American Gas Association Monthly" by Mr. ALEX. M. BEEBEE, the Assistant Superintendent of Gas Manufacture to the Rochester Gas and Electric Corporation.

Referring to the removal of coke by gravity upon the opening of the bottom lids of the vertical retorts at the Corporation's West Station, Mr. Beebee says this principle of coke removal certainly has all the theoretical earmarks of an ideal system. However, when the West Station was started, it was soon found that theory and practice did not always pan-out, and that many of the charges failed to drop out of the retort after opening the lower lid. These "stuck" charges are removed by poking from the bottom, which is not only a very dangerous practice, and also most annoying (as it ties-up the operation considerably, which means loss in plant capacity), but it also causes considerable damage to the plant equipment. The retorts are opened in batteries of three at a time; and if one or two should drop, it means that the hot-coke car and lower retort ironwork will be subjected to considerable heat from the hot coke of the dropped retorts, while waiting for the stuck charges to be removed. This was particularly ruinous to the hot-coke car equipment; for the plates became hot when delayed too long, and consequently were considerably distorted in the quenching process. These difficulties, if unsolved, presented a serious drawback to vertical retort operation; and considerable experiment and thought were given to the problem. But it was some time before any results were realized, as the causes were many, and each in itself is capable of producing considerable difficulty.

The retorts in the West Station installation are about 22 ft. 5 in. in length, with a slight taper from the top to the bottom, to aid the coke charge in falling, and with gas offtakes from the top and base of the retort. The retorts are built-up of silica brick with the exception of the bottom 8 in. next to the lower lid, which is of firebrick. Before a charge of coal is placed in the retort, about 10 in. of coke breeze is put in, in order to keep-up the coal in the heated zone of the retort and thus ensure that the complete coal charge will be completely carbonized at the conclusion of the draw. If this breeze mat were not used, the coal in this lower area, which is comparatively cold, would be only partially carbonized, and, being in a sticky plastic state, would cement itself to the sides, causing the charge to stick. This breeze area was theoretically supposed to prevent any possibility of a sticking retort. Soon after starting operations, however, it was discovered that such was not the case, and that between 35 and 40 p.ct. on an average of the retorts stuck, and that there must be something further that caused the charge to fail to drop.

After considerable investigation and very careful watching, the following conditions were proved capable of causing, or helping to cause, a sticking retort; and they are listed in the order of their effectiveness in aiding such a condition. The first item is, of course, self-evident, and did not take long to find out.

(1) Absence of the breeze mat at the bottom of the retort, or failure to have sufficient breeze to make the mat of proper depth. As the amount of breeze put in each retort is mechanically measured and is a regular part of the charging operation, this is unlikely to be the cause of continued trouble. However, failure in the proper completion of this operation is more sure than anything else to cause a sticking retort. In case of trouble, this is one of the first things to investigate—to make sure that each retort is getting its proper amount of breeze. This was one of the first things that we looked to; but still there were other factors that seemed to be nearly equally effective in preventing the coke charge falling.

(2) The failure to have a proper heat condition in the retort will probably, more than anything else (aside from the absence of breeze) cause a charge to stick. The reason for this is obvious; for unless sufficient heat condition is reached, the breeze mat will not have become sufficiently heated by the time the end of the charge has arrived to drive-off the high boiling-point tars that have condensed in the breeze during the earlier part of the charge. If the temperature is not sufficient to drive-off these tars, the breeze mat remains a plastic tarry mass that adheres to the side of the retort bottom. It has been proved beyond a doubt that a proper heat condition in the retort is of primary importance in maintaining good dropping of charges. Another reason why a well burned-off charge will drop better may be because such a charge is apt to be more thoroughly shrunk away from the sides of the retort, and hence its whole weight is supported on the breeze mat.

(3) Careful watching showed that the breeze mat condition also had considerably to do with a stuck charge; for we still had trouble, in spite of good retort temperatures. With this in mind, attention was turned to the proper treatment of this breeze mat. Since coke breeze in itself should cause no trouble, it must be the mixture of the breeze and various tars from the coal that caused the trouble; and the next step was to prevent as much as possible the tar coming in contact with the coke breeze. Coke breeze necessarily contains over 10 p.ct. of moisture, as the small particles of coke do not, after quenching, have a hot centre which will drive off the moisture from outside, as is the case with larger pieces of coke. As a result, this wet breeze, when put in the bottom of the retort, being colder and slower to rise in temperature, due to this moisture, would condense tar from gas passing down through the breeze to the lower offtake; and as this moisture in the breeze would absorb considerable heat itself in vaporizing, the beeeze mat at the end of the charge would not be at a temperature sufficiently high to vaporize all the tars, and the sticky mass resulted. The solution to this was to dry the breeze, and then heat it to about 230° before putting it into the retort. This was carried out by installing nearly 2000 ft. of high-pressure steam-coils in each of the three breeze-bins; and as a result the breeze moisture is reduced to around 1 p.ct., and the temperature of the breeze before going to the retort is raised to some 230°.

(4) It was further found that the fineness of the coke breeze also had its effect on the mat; and the reason for this is clear. If large breeze is used, it provides a freer medium for the gas to pass through the breeze mat to the lower gas offtake from the retort than would be the case if smaller breeze were employed. The more gas that passes through the mat, the more tar will be condensed; and hence it was found that using a small grade of breeze helped the difficulty, as it tended to force more of the gas up through the retort and out of the upper gas offtake, thereby reducing the tar condensed in the mat.

(5) The fifth solution was really an outgrowth of the preceding one, in that it consisted in manipulating the valves in the lower offtake pipes—keeping these valves closed at all times as far as was possible, and still not cause the lower lids to leak, so as to provide additional means to force more of the gas to take the upward path through the retort to the upper offtake pipes.

(6) The bottom 8-in. section of the retort is made of fireclay. This portion is subjected to more or less expansion and contraction, and also to abuse when poking retorts; and as a result pockets had been worn into it. These pockets made ideal resting places for the breeze to catch and cause a stick. Keeping these sections patched, so as to provide a smooth surface, also helped in the elimination of the trouble.

The application of any one of the foregoing remedies in itself will not clear the situation. This was one reason why the problem was so long in being solved, as any one correction made did not seem to cause material benefit; but taken all together, the situation changed, and the "sticks" were reduced from around 35 p.ct. to an average of 5·7 p.ct. when on full plant operation. The few that still refuse to drop are of such a nature that they are easily removed, with almost no delay. The long hard poking has been completely eliminated.

The will has been proved, at £7623 gross, of the late Mr. Archibald Tennent Eastman, of Walbrook, E.C., who died at the age of 64. Mr. Eastman was a Director of the European Gas Company, Ltd., and the Oriental Gas Company, Ltd., and an Auditor of the Continental Union Gas Company, Ltd.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

"Field's Analysis" and the "Declared" or "Supplied" Calorific Value.

SIR,—Now that "Field's Analysis" for the year 1920 has been published, my thoughts are directed to the question of the issue of this publication next year.

I think it may safely be assumed that the current edition is the last one that will appear with results worked on the basis of the 1000 c.ft. sold, as it is hoped that sufficient information will be available to permit of the next edition being issued with results based on the therm. This being so, the question in a general form arises as to whether, for statistical purposes, the "declared" or the "supplied" calorific value is the correct figure to be used for ascertaining the number of therms sold. In my opinion, the supplied value should be used, as it would give the actual number of heat units delivered, and would be in harmony with the expenditure involved in the manufacture of the gas; whereas the declared value in this connection would appear to fulfil the function merely of a medium for charging the consumer. Naturally, the supplied and the declared calorific values will be closely allied; but there will, as a rule, be sufficient variation to affect results. The margin of supplied above declared will almost certainly differ in most cases, and costs (all other things being equal) will vary accordingly.

It may be remembered I touched upon this subject in the article which I had the pleasure of writing for the series that appeared in the "JOURNAL" at the commencement of this year, when I stated that it might be possible that a new factor would have to be introduced into our accounts, somewhat in the form of an "unaccounted-for" figure. If, however, the supplied figure only is dealt with in all statements of gas made, sold, used on works, &c., this difficulty will not arise.

As regards "Field's Analysis," it will be impossible at first to show results for comparative purposes, on any other basis than that of the heat units supplied, as many of the undertakings will not have come under the Gas Regulation Act and will not, therefore, have declared a calorific value.

The above is the method I would suggest for stating the quantity of gas made, sold, &c., in half-yearly and yearly accounts.

The number of therms actually charged for on the basis of a declared calorific value of 475 B.Th.U. would, in this case, have been 151,826,829, which figure is, I submit, not needed in the above statement.

It would be interesting to know the opinion of your readers with regard to this matter.

H. E. IBBS, Accountant.

Gas Light and Coke Company, Horseferry Road, S.W.
May 31, 1921.

"Trading on Falsehood."

SIR,—My attention has been drawn to a paragraph in your June 1 issue, headed "Trading on Falsehood," which indirectly casts a reflection upon the "Western Morning News." May I set out the case as it affects us?

We received the letter from a gentleman whose name and address are well authenticated; and we looked upon the letter from "A Very Old Reader" as a matter of a certain amount of interest—especially as at this present time the coal crisis is becoming more and more acute, and therefore people are more and more interested as to the most economical method for motor and lighting power.

I regret that if there was any inaccuracy contained in the letter, no reply was made, putting the view of the economy of gas, as I am sure it would have been a matter of great interest to our readers.

A. EDWARD SPENDER, Managing Director,
"Western Morning News."

Plymouth, June 3, 1921.

[A copy of the paragraph, side-headed "Light from Ounces of Coal," that appeared in our "Electric Supply Memoranda" on May 25 was forwarded to the Editor of the "Western Morning News" last week. In that paragraph there is sufficient answer to the absurdities in the letter of which complaint is made, and which appeared in other country papers besides our esteemed Plymouth contemporary.—ED. "G. J."]

A Fitting (?) Presentation.

SIR,—I was pleased to read the account of the presentation to Mr. James Bridge [see "Personal" column in your issue for June 1]; but why should a gas engineer be presented with candlesticks?

TOD.

June 3, 1921.

A Joint Supply of "Reparation Coal."

SIR,—It might be of some interest to your readers to know that, on behalf of this Association, I have been able satisfactorily to negotiate a cargo of "Reparation Coal." The coal was loaded at Dunkirk and discharged at Truro, from which port it was distributed by rail without a hitch to the various Cornish undertakings which were almost exhausted.

No tests have been made with the coal; but I shall be pleased to supply particulars as soon as they are available. Up to the present, no Cornish works have had to close-down.

F. G. KINGWELL, Hon Secretary,
Cornish Association of Gas Managers.

Gas Offices, Falmouth,
June 3, 1921.

GAS LIGHT AND COKE COMPANY—YEAR 1920.

	Quantity Made.			Quantity Sold.			Quantity used on Works, &c.	Total Quantity Accounted for.	Quantity not Accounted for.
	Thousands.	Calorific Power. (Actual).	Therms.	Public Lights, &c., under Contract. (Estimated.)	Private Lights. (Per Meter).	Total Quantity Sold.			
Gas	*35,148,709	B.Th.U. 485	170,471,239	Therms. 4,678,058	Therms. 150,345,126	Therms. 155,023,184	Therms. 2,688,481	Therms. 157,711,665	Therms. 12,759,574

Including 7,350,793 thousands of carburetted, &c., water-gas.

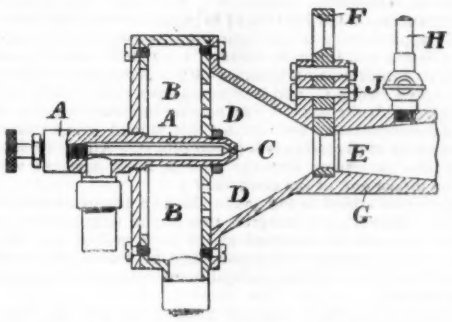
REGISTER OF PATENTS.

Injector Mechanism for Supplying a Mixture of Gas and Air.—No. 162,349.

SHARP AND PRESTON, LTD, and DOCKING, A., of Dublin.

No. 1555; Jan. 17, 1920.

This invention relates to injector mechanism for supplying gas and air to stoves, furnaces, and the like; and its object is "to obtain a mixture of the correct proportions under all the varying conditions which are set up from time to time."



Docking's Injector Mechanism.

The air supply pipe A is carried through the centre of an annular gas-supply casing B; and the delivery jet C at the inner end of the supply pipe projects right into a mixing chamber D, preferably made in the form of a truncated cone. The smaller end of the chamber is provided with an outlet passage E, which is co-axial with the air-jet, and is connected to (say) a stove or furnace. The air-jet—which is supplied with air under a constant pressure—is controlled by a needle valve carried through a gland in the supply pipe, and has a pointed inner end which can be screwed-down on to a seat provided for it at the back of the air-jet.

The casing B is provided with a gas inlet and a series of outlet openings or perforations, disposed in its inner wall round the air supply pipe, so that the gas is delivered through the openings or perforations direct into the mixing chamber.

The gas is supplied through a governor, preferably connected direct to the inlet of the gas-supply casing B. This governor is adjusted to reduce the gas pressure to that of the atmosphere; so that the gas is drawn into the mixing chamber solely by the injector action set up by the air delivered from the jet C.

The outlet from the chamber D is made adjustable, by fitting a disc F with a series of apertures of varying sizes in the outlet passage E; the arrangement being similar to that described in patent No. 126,412. The disc is disposed in a space provided for it in the main casing G; and it is centrally pivoted on a bolt J between the lugs on the casing, so that it can be turned round to adjust any of the openings to register with the outlet passage E, and thus determine the area of the outlet.

The proportions of the mixture are varied as required by altering the size of the outlet—that is to say, a rich mixture is obtained by increasing the outlet, and a poorer mixture by reducing it; and as the air pressure can be maintained constant and the gas pressure reduced to that of the atmosphere, the mixture remains constant under variations of the pressure of supply when once it is adjusted.

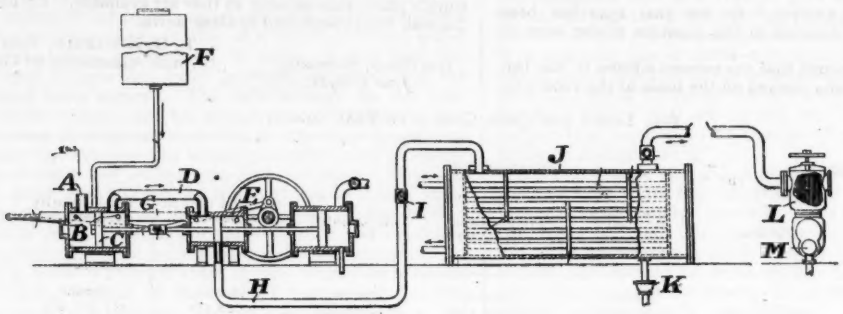
A test burner H, connected to the mixed air and gas supply or to the outlet passage E (as shown), is preferably provided for testing, thus facilitating the adjustment of the proportions of the mixture.

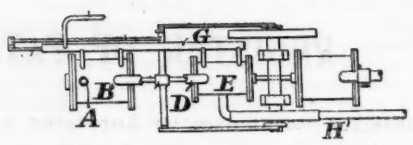
Purification of Gases.—No. 159,905.

FELT, W. O., of Brooklyn, New York.

No. 13,638; Sept. 22, 1917.

This invention relates to the purification of illuminating and other gases "whereby impurities may be removed with great celerity and small cost by a simple and inexpensive plant."





Felt's Gas Purification Process.

There are shown a diagrammatic side elevation of the preferred form of apparatus employed and a partial plan view of it.

In carrying out the process, illuminating gas from which the tar has preferably been extracted, or gas of any desired constitution, containing one or all of the impurities ordinarily found in gas—such as carbon dioxide, sulphur, carbon disulphide, and other sulphur compounds, ammonia and ammonia compounds, and other liquid, gaseous, and solid substances—is fed into the inlet pipe A of the cylinder B; and the piston C, upon moving to the right from its extreme left position, compresses this gas and forces it through the pipe D into the cylinder E. During this compression a quantity of glycerine passes from the tank F to the valve casing G, and is injected into the cylinder B and there commingled with the gas. Upon passing into the cylinder E the gas is further compressed; and during this second compression an additional quantity of glycerine is injected into it. After this second compression the gas passes into the pipe H, flows past the valve I and enters the intake end of the condenser J.

The glycerine added to the gas in the two compression cylinders is capable of preventing a material rise in the temperature of the gas over the temperature obtained at the inlet end of the low-pressure cylinder. The pressure employed may be varied, according to the operative conditions—being preferably maintained at or about 300 lbs. per square inch.

The gas and glycerine mixture constituting the resulting product passes into the condenser and is there cooled to a temperature of at least 60° Fahr. A portion of the mixture may be condensed by this contact and any condensate may be trapped at K. A majority of the mixture will, however, pass along to an extractor L of known construction. The glycerine, after passing through the condenser, appears as a fog which is held in suspension by the gas. Upon contacting with the baffle plates in the extractor, the glycerine, together with the impurities which are present in the gas, fall to the bottom of the extractor and ultimately may be trapped-out through the valve M. The gas, freed from the glycerine and other impurities, passes in a purified state from the extractor and is ready for distribution.

The glycerine thus injected into the pressure cylinder acts as an absorbent agent and removes from the gas the ammonia, sulphur, carbon dioxide, &c., impurities, and when the fog, comprising the glycerine and impurities, falls to the bottom of the extractor and is tapped off, the gas is substantially free from "these contaminating substances." The gaseous impurities in the glycerine (such as ammonia, carbon dioxide, and hydrogen sulphide) fly off when the pressure on the glycerine is removed—that is, when the glycerine and impurities are tapped from the extractor. Such fixed salts as ammonium carbonate, ammonium sulphate, and the like, which enter with a certain amount of water, and remain in solution in the glycerine, may be got rid of by concentrating the glycerine and thereby precipitating them from the solution. The glycerine may be used over and over again, being preferably pumped back to the tank F and from there introduced into the cylinders B and E as already indicated.

Coin-Freed Gas-Meters.—No. 162,507.

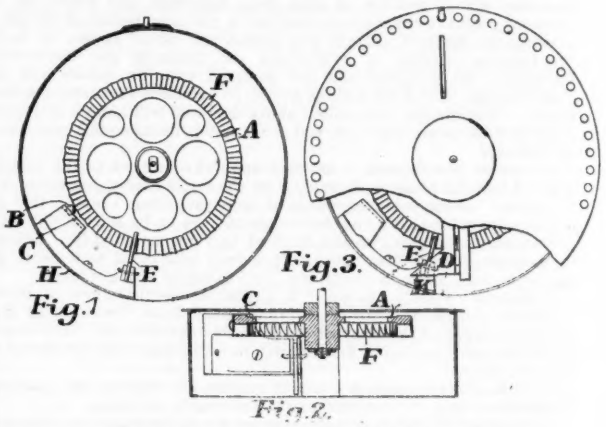
GLOVER, W. R., and WHIMSTER, J. I., of Edmonton.

No. 9033; May 27, 1920.

This invention relates to a modified form of coin-freed gas-meters described in patent No. 25,272 of 1894, for preventing any backward movement of the crown wheel at any time during the traverse of a coin in the coin-carrier arm or any forward movement of the crown wheel greater than that intended.

Fig. 1 is a front view of a portion of the new meter with the price-changer plate removed and showing appliance and the wheel connected with the meter mechanism. Fig. 2 is a section of fig. 1. Fig. 3 is a front view of the portion of the meter shown in fig. 1, but with the price-changer plate attached.

The peripheral edge of the crown wheel A is found smooth, rough, serrated, milled, or deviced for engaging a ball B or roller positioned in a cam or angled track C—the ball being so positioned that when the crown wheel, which is connected with the mechanism, is moved in its proper direction, the ball rides free; but the moment any attempt is made to move the crown wheel backwards, its edge immediately jambs the ball in the cam or track, and such movement is prevented. To prevent any forward movement of the crown wheel by momentum when the coin is released, there is positioned near the end of the travel of the coin-carrying arm D a pivoted rocking lever E. One end of this is in the path of the arm, so that as it is reaching the end of its movement it acts upon the end of the pivoted rocking lever E (preferably by an angled end K) and pushes the other end between two of the teeth F of the crown wheel; thus preventing further movement.



Glover and Whimster's Coin-Freed Gas-Meter.

By this invention in the one case the crown wheel is prevented being given a backward movement when the coin is actuating the crown wheel, and in the other case it is prevented being given a forward movement by a sudden and swift movement of the coin-carrier arm.

Gas Calorimeters.—No. 162,826.

FAIRWEATHER, J. H., of Brentford.

No. 4228; Nov. 4, 1920.

This invention has for its object to provide means for supplying water to gas calorimeters at a rate of flow corrected for atmospheric conditions of temperature and pressure. To this end the water passes through apparatus in which the temperature of the water and the atmospheric pressure are both caused to act upon means regulating the flow of the water.

Fig. 1 is a sectional elevation of one form of float-operated apparatus adapted to be connected to any desired form of calorimeter. Fig. 2 shows a modified form of the apparatus.

In fig. 1, the apparatus comprises a preferably cylindrical vessel in which is supported a closed air-tight vessel A of less diameter, having about its centre an oil chamber B, formed by a partition C secured to the interior. The air spaces above and below the oil chamber so formed are put into communication by a tube D passing through the outer vessel. The oil chamber communicates by a tube E with a float chamber F provided in an adjacent vessel G (hereafter described). The top of the air vessel A is provided with an extension open to the air, and adapted to contain a portion of the water passing to the calorimeter, the water entering at the bottom of the extension through the pipe I and flowing over the top edge down over the air vessel and out through a drain [not shown]. Thus the air in the vessel is maintained at the temperature of the water used for the calorimeter.

The extension on the air vessel is further connected by a pipe J near its upper edge to a vertically arranged vessel having an outlet pipe K at the bottom through which the water passes to a container L open at the top and carried upon a rod attached to the float M in the float chamber arranged in the vessel G. The water flows over the top edge

of the container down into the vessel and passes thence to the calorimeter through the outlet N. The float chamber (protected from the flow of water by a cover) is in communication with the atmosphere; and the float rests on the surface of oil admitted from the oil chamber B.

The float chamber is so constructed that the movements of the float produce the correct changes in the head of water to compensate for variations in the tabular number of the gas—that is, the amount of gas at the standard temperature and pressure in 1 c.ft of gas as measured by the meter used in connection with the calorimeter.

The operation of the apparatus is as follows: A portion of the water entering the extension H of the air vessel overflows, and passing over the vessel keeps the air therein at the temperature of the water. Any change in temperature is thus communicated to the enclosed air column, which is also affected by any change in the atmospheric pressure, since the float chamber F is in communication with the atmosphere. Any consequent change in the air pressure within the vessel A causes the oil in the chamber B to be more or less affected; oil being driven into the float chamber causing upward or downward movement of the float. When the float M rises, it carries up the water container L, thus

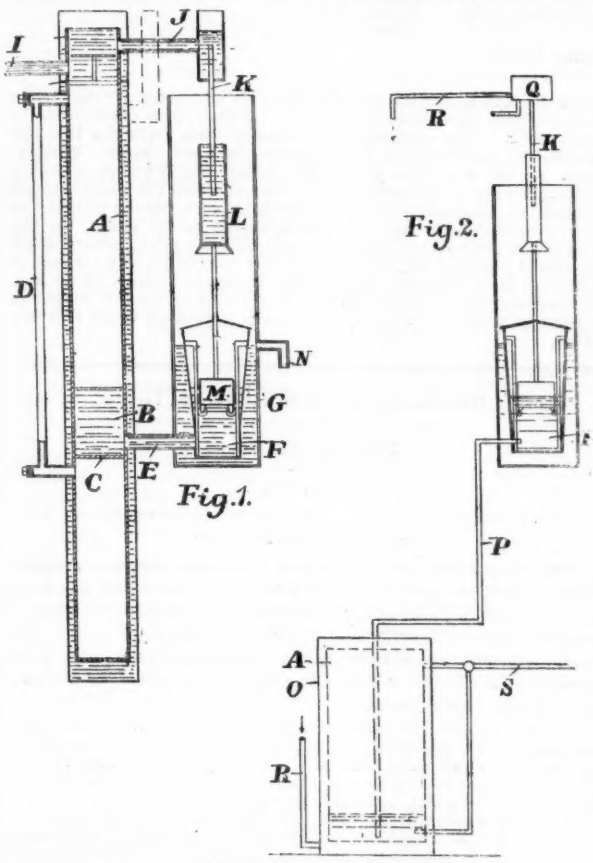


Fig. 1.

Fairweather's Gas Calorimeter.

lessening the head of water and causing a diminution in the flow to the calorimeter; and when the float falls the action is reversed and the flow of water is increased. As the float chamber is so constructed that changes in the rise and fall of the float correspond to changes in the tabular number of the gas, it follows that the flow of the water to the calorimeter will be corrected automatically for changes in temperature and atmospheric pressure. Thus the calorific value of the gas can be obtained without the necessity of any further calculations in respect of the changes—*i.e.*, by supplying gas to the calorimeter at a constant rate by a clock-driven meter, the calorific value of the gas can be determined directly from the rise in temperature of the water passing through the calorimeter.

Fig. 2 is a modified form of the apparatus, in which the long outer vessel is dispensed with, enabling the closed air vessel and oil chamber to be placed at a lower level than the float chamber—some advantage in arranging the apparatus. The closed air vessel A is supported in an outer vessel O; and a layer of oil is admitted to the bottom of the vessel by pipes, fitted with suitable cocks. A pipe P, passing through an air-tight connection in the top of the vessel A, has its lower end always sealed by the oil layer, and passes up into the float chamber F, which in this case is above the level of the oil in A.

The general design and arrangement of the float and chamber and the water regulating arrangements are as described with reference to fig. 1 except that the main supply enters a vessel Q connected to the pipe K; a portion of the water passing through the pipe R into the bottom of the vessel O, whence it flows over the air chamber A and out through a suitable outlet [not shown].

In this arrangement, since the air chamber containing the oil is below the level of the float chamber F, in starting the apparatus sufficient air pressure must be maintained in it to force the oil in the float chamber up to the standard level to obtain the standard rate of flow of the water. To this end, compressed air may be admitted through pipes S.

The operation of this apparatus is as described with reference to fig. 1.

Fig. 2.

[Discharging Ammonium Sulphate from Saturator Baths.—No. 145,781.

F. J. COLLIN, AKTIENGESELLSCHAFT ZUR VERWERTUNG VON BRENNSTOFFEN UND METALLEN, of Dortmund, Germany.

No. 18,165; July 2, 1920. Convention date, April 2, 1919.

In the production of ammonium sulphate by the direct conduction of coal gases in a cooled state through an acid bath, the inconvenience arises (the patentees point out) that it is not practicable to syphon the sulphate out of the saturator by steam, as the bath cools and condenses the steam, so that a considerable precipitation of water occurs and dilutes the bath. To avoid this, the syphons have heretofore been operated by means of compressed air; but in this case the disadvantage arises that the expanding air cools the bath, and the local cooling results in incrustation near the syphon. This frequently causes obstruction of the syphon, and leads to considerable difficulties.

To obviate this, the air used for syphoning is, according to the present invention, heated in an apparatus provided for the purpose, before it enters the saturator; so that, at least in the vicinity of the syphon, the air heats the bath to a degree wholly preventing incrustation. The heating of the air (done directly or by steam or otherwise) can, however, if desired, be carried to such a degree that a substantial heating of the whole bath is obtained. By heating the air its volume is increased; so that the quantity required for syphoning is reduced.

Purifying Coal Gas by Means of Ammonia. No. 147,583.

CARL STILL, of Recklinghausen, Westphalia.

No. 19,518; July 8, 1920. Convention date, Dec. 10, 1917.

The invention relates to a method of purifying coal gas, in which the cooled crude gases containing ammonia are freed from their chief impurities—hydrogen sulphide and carbonic acid—by introducing additional ammonia; and it refers more particularly to the carrying-out of the purification in which the ammonia used for purifying is brought into contact with the gases in the form of an ammonia solution.

The diagram on p. 558 shows (in elevation, partly in vertical section) a suitable arrangement for carrying out the process when applied to coke-oven gas.

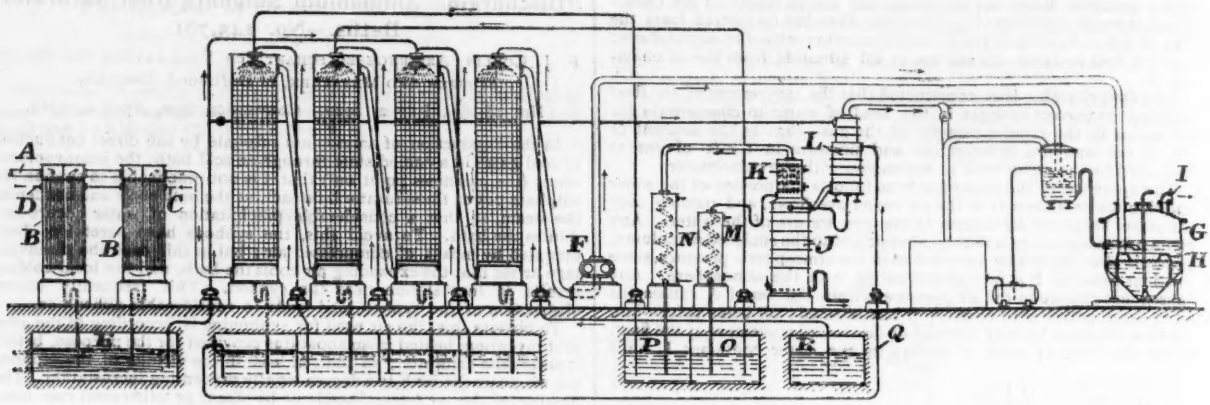
The crude gases, charged with tar, ammonia, hydrogen sulphide, carbonic acid, and other impurities, are first led through the pipe A to a set of water-tube condensers B, in order to cool them to about the temperature of the external air. The condensers receive cooling water at C and discharge it hot at D. The tar separates and also the main portion of the steam in the form of a weak ammoniacal liquor; and both flow to a tank E, in which they separate into a lower layer of tar and an upper layer of ammoniacal liquor. A coil in the tank cools the hot ammoniacal liquor, in order to make it suitable for its later use as ammoniacal washing water. From the condensers the gases (now free from tar) pass to the four scrubbers shown, in which ammonia, hydrogen, sulphide, carbonic acid, and other impurities are removed. The scrubbers are sprayed at the top with the washing liquid, and have as outlets each a separate collecting tank; while pipes are arranged for the passage of the gases so that they pass through the four in succession. For raising the various scrubbing liquids there is provided for each scrubber a pump with a delivery pipe. From the last scrubber the gases pass to a pump F, which produces the movement of the gas through the whole apparatus, and then to a saturator G having a bell H, in which the ammonia remaining in the gases is absorbed by sulphuric acid and thus obtained as solid ammonium sulphate. From the saturator the gases (free from ammonia) pass at I to the place where they are to be used.

The apparatus also comprises a plant for working-up the ammoniacal liquor. This consists of a column still J with a reflux condenser K; a second column L for separating the carbonic acid and hydrogen sulphide, with a washing column above it, and the two condensers M N, To this plant also belong the two receiving tanks O and P, for the condensers M and N, and the pump for supplying the ammoniacal liquor to be treated. The pump draws the ammoniacal liquor through a pipe Q from the tank under the first gas-scrubber and delivers it by pipe to the top of the column L, from the bottom of which it flows through a syphon pipe to the top of the ammonia still J.

The steam from this still passes to the bottom of the column L, while fresh steam enters the bottom of the still; while a pipe removes the spent liquor from the still. The ammoniacal liquor flowing through the column is heated to a temperature somewhat below 100° C. by the counter-current of hot steam entering from the still J, augmented, if desired, by a supply of fresh steam, whereby the impurities accompanying the ammonia—mainly hydrogen sulphide and carbonic acid—are almost completely expelled.

The liquor which has been treated in the column L, and now contains practically only ammonia, flows to the top of the still J, in which it is deprived of the whole of its free and fixed ammonia by the action of steam and lime; so that it finally flows away as fully spent liquor. The mixture of ammonia and water vapour driven off, in so far as it does not pass to the column L, passes to the reflux condenser K, and then away. In the reflux condenser (which may be, for example, a simple water-cooled tubular condenser) a part of the water vapour is condensed, carrying with it a portion of the ammonia. This condensate—a comparatively strong solution of ammonia, containing about 10 p.ct.—is passed to the worm cooler M, in order to be cooled to normal temperature, and is finally collected in the tank O. The vapour passing off is condensed to an ammonia solution of a high degree of strength, about 20 to 25 p ct., and simultaneously cooled to normal temperature before it flows to the tank P.

The ammonia solutions of different strengths obtained in the recovery plant and stored in the tanks O and P are now used as washing liquids in the first two scrubbers, where they meet the most crude gas and remove from it most of the hydrogen sulphide and carbonic acid. For this purpose the highly concentrated solution from the tank P is



Still's Gas-Purifying System.

pumped to the top of the first scrubber, and the less concentrated solution from the tank O to the top of the second scrubber. In this manner, from the gases which enter the first scrubber with the whole of their impurities, the highly concentrated ammonia solution removes the greater portion of the impurities—the remainder being washed out in the second scrubber by the weaker ammonia solution. An advantageous use of both grades of ammonia solution obtained during the operation is thus secured, and the otherwise usual return of the condensate from the cooler K to the column still J, which considerably increases the working costs, is avoided. The washing liquid running away from the first two scrubbers collects in the tanks below. The gases issuing from the second scrubber contain essentially only ammonia, which is now washed-out in the third and fourth scrubbers. For this purpose the third scrubber is sprayed with the ammoniacal liquid from the tank E, and the last scrubber with fresh water for the further and complete washing of the ammonia. This water is drawn from the reservoir R. The washing liquid running away from the first two scrubbers is collected in the corresponding reservoirs below. Furthermore, for the first three scrubbers separate supply pumps, with corresponding pipes, are provided, by means of which the washing liquid—containing ammonia—running away from each can be supplied to the scrubber which has just been traversed by the gases. In this manner all the washing liquids are combined to a united stream which is passed through all the scrubbers in succession (its content of ammonia being increased step by step) in counter-current to the flow of the gases, and is finally collected in the tank of the first washer as a strong ammoniacal liquor, which is then worked-up in the recovery plant.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Progress of Bills.

A report from the Standing Orders Committee that the Standing Orders not complied with in respect of the petition for additional provision in the Batley Corporation Bill ought to be dispensed with, was read and agreed to.

HOUSE OF COMMONS.

Progress of Bills.

The Wigan Corporation Bill, as amended, was considered, and read the third time.

The Tendring Hundred Water and Gas Bill: Read a second time, and committed.

The Thames Deep-Water Wharf and Railways Bill was reported. [Preamble not proved.]

The Cardiff Gas Bill: Reported, with amendments.

The Rotherham Corporation Bill: Reported, with amendments, from the Local Legislation Committee (Section A).

The Swansea Gas Bill: Reported with amendments.

It was reported that no Standing Orders were applicable in the case of the Hamilton Water and Gas Provisional Order Bill, and it was read a second time.

A requisition to withdraw a petition against the Waltham and Cheshunt Gas Bill has been made by the Lee Conservancy Board. The Bill has now been referred to the Committee on Unopposed Bills.

Public Utility Companies (Capital Issues) Act, 1920.

Copies were presented of reports by the Board of Trade under the Act on applications by the Newark Gas Company, Nuneaton Gas Company, Penistone and District Gas Company, and Queenstown Gas Company.

Smoke Abatement.

Mr. Trevelyan Thomson asked the Minister of Health whether his attention had been drawn to the appreciable improvement in the health of urban populations at the present time, attributable by many medical authorities to the purer condition of the atmosphere due to reduced coal consumption; and had he considered the possibility of securing these same health advantages by means of measures for smoke abatement when coal consumption again became normal.

Sir Alfred Mond (the Minister of Health) replied that the time during which the consumption of coal had been reduced had not been sufficient for the confirmation or contradiction of the suggestion in the first part of the question. The whole question of the pollution of the atmosphere by smoke and other noxious vapours was receiving the consideration of a Departmental Committee under the Chairmanship of Lord Newton. He had no doubt that the Committee were fully conversant with the aspects of the problem referred to.

HOUSE OF COMMONS COMMITTEE.

SWANSEA GAS BILL.

Tuesday, May 31.

(*Before Sir* Harry Samuel, *Chairman*, *Mr.* Hopkins, *Mr.* G. H. Hirst, *and Sir* Douglas Hall.)

The Bill, promoted by the Swansea Gas Light Company, proposes to empower them to sell gas on the therm basis, with a basic price and basic rates of dividend—the dividends to be increased as the price of gas falls below the basic price. Part of the profits resulting from the good working of the Company, as represented by the fall in the price of gas, is to be distributed among employee co-partners. The Bill also seeks to raise further capital.

Counsel for the Bill were Mr. W. B. Clode, K.C., and Mr. Szlumper. The opponents were the Swansea Corporation, represented by the Hon. Evan Charteris, K.C., and Mr. Bruce Thomas; and the Great Western Railway Company, represented by Mr. W. E. Tyldesley Jones, K.C., and Mr. Rowand Harker.

Mr. W. H. Johns (the Engineer and Manager of the Swansea Gas Company), Mr. W. Doig Gibb, and Mr. W. A. Scott were in attendance to support the Bill, but were not called upon to give evidence owing to the turn the case took.

The Chairman, at the opening of the proceedings, said the decisions the Committee had given on the Cardiff Gas Bill the previous week* seemed to govern the Swansea case, with the exception of the financial provisions and the question of the fixing of the basic price.

The Hon. Evan Charteris, on behalf of the Swansea Corporation, said he accepted the principles laid down by the Committee in the Cardiff case; but the sole question so far as he was concerned was the determination of the basic price. In this connection, he suggested that, as there was at the moment an application by the Company to the Board of Trade under the Gas Regulation Act, 1920, the Board of Trade and not the Committee should fix the basic price. Unlike the position with regard to Cardiff, the Board of Trade had not yet conducted an inquiry into the Swansea case; and therefore the question came before the Committee without any pre-judgment. The fixing of the basic price before the Committee would involve an investigation of the schedule submitted to the Board of Trade, and some detailed inquiry, which, in the interests of time, they should avoid.

The Chairman said it seemed to him that this must and should be the course, although he had not consulted the Committee on the point. They had absolutely insisted that the revision of the basic price and the calorific value should be in the hands of the Board of Trade at any time when it was necessary that they should be revised, and, therefore, if they were the authority to revise, surely they should be the authority to fix.

Mr. Harker (for the Great Western Railway Company) said that his clients' opposition dealt with the question of pressure. It might be convenient, therefore, to deal with the general aspect of the Bill first, and to take the points raised by the Railway Company later.

Mr. Clode asked that the case should be determined by the Committee, as in the Cardiff Bill.

The Chairman pointed out that the Cardiff price was decided by the Board of Trade before the Bill reached the Committee.

Mr. Clode said that was the maximum price, and not the basic price. The Board of Trade, he maintained, could not do what the Committee

* See "Journal" last week, pp. 485-9.

had done—*i.e.*, settle the basic price and basic dividend. He contended that the Board had not the power, and had never exercised any power, to fix a basic price, basic dividends, and distribution of profits.

Mr. HOPKINS (a Member of the Committee) suggested that a clause be inserted in the Bill providing that the Board should fix the price.

Mr. CHARTERIS pointed out that under section 1 of the Gas Regulation Act the Board were limited as to what they could do; but under section 10 there was power which was clearly intended to cover any possibility of this character.

Mr. CLODE said that was a Special Order which must be laid upon the Table of the House and get parliamentary sanction, and a resolution must be made approving it.

Mr. CHARTERIS, however, said there was no matter of doubt that the basic price could be determined by the Board; but Mr. Clode would not agree.

Mr. CLODE, proceeding to open the case for the promoters, said the Company were incorporated in 1830. Various capital issues had been made between that time and 1898, when it was consolidated into a uniform stock, with a maximum dividend of 5 p.ct. The present capital authorized was £522,400, of which £380,894 had been raised, including premiums; leaving a balance of £141,105. The loan capital authorized was £261,000, of which £61,600 was issued, leaving a balance of £199,400.

In answer to the CHAIRMAN, Counsel said that the maximum dividend of 5 p.ct. had been paid for a period of fifty years.

Continuing, Counsel said that in 1888 the maximum price of gas within the borough was fixed at 3s. 6d. per 1000 c.ft. and 5s. outside the borough. From Jan. 1, 1911, as fixed by the Company's Order of 1910, the price was the same within a mile of the borough boundary is within the borough itself, and beyond that distance the price must not exceed 4d. per 1000 c.ft. above that price, except in the parish of Oystermouth, where the price was 5s. Under the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, the prices had been increased, and at the present time the charge was 6s. 2d. within the borough, as existing in 1910, and within a distance of a mile from the boundary. This was the actual charge at the present time. The average calorific value of the gas supplied during the year 1920 was 450 B.Th.U. The present works of the Company were very much overcrowded and overtaxed, and the present estimated expenditure for works was £442,000. The coal-gas and water-gas plant were not equal to the demands made upon them; and they had been warned by their engineer from time to time that a breakdown might be expected. Both manufacturing and distributing plant were totally inadequate, and there were frequent complaints from consumers as to the pressure of the gas supplied. This could not be remedied unless, in addition to the manufacturing plant, further large high-pressure distribution mains were laid. The rate of increase of demand between 1916 and 1920 was 7 p.ct. compound, and assuming the same rate of increase up to 1925, the demand would then reach 1080 million c.ft. per annum. They wished to instal additional plant which would yield another 2½ million c.ft. of gas per day. As to the financial position, notwithstanding the increases under the Temporary Increase of Charges Act, the working of the Company had shown serious deficits since 1914. Since 1918 the dividend had been reduced to £3 15s.; so that the circumstances were exactly the same as in the case of Cardiff, except that the necessity for raising further capital was more urgent in Swansea. There was an overdraft from the bankers of £89,000, which, together with the capital needed for works and distribution services, totalled £678,105. It was proposed in the Bill to raise £225,000 of additional capital, *plus* £112,500 borrowing powers. This, with unissued share capital of £141,105, and loan capital of £199,400, totalled £678,005. The basic price asked for was 1s. 7·8d. per therm in an area within a mile of the borough boundary, but beyond that distance 1s. 8·6d. per therm. As to the dividends, the charges for new capital were very high in this case, and that was why the price for gas supplied was so much higher than in the case of Cardiff. [The price fixed for the Cardiff Company was 1s. 2·4d.] The price was based on the net cost of manufacture (70·41d. per 1000 c.ft.), *plus* an average of what the capital charges would be over the four years 1922-25, which was 18·79d.; making a total of 7s. 5·20d. per 1000 c.ft., which was 1s. 7·8d. per therm for a 450 B.Th.U. gas.

Mr. CHARTERIS again raised the question as to whether it would not be more desirable to refer the matter of the basic price to the Board of Trade, because such minute details had to be considered. He did not dispute the principles laid down by the Committee in the Cardiff case, nor the need for fresh capital.

The CHAIRMAN said that if the Committee were quite clear that the Board of Trade would apply clause 10 (as to participation in benefits resulting from good working), then he was rather in agreement with Mr. Charteris. The Committee, however, insisted upon the inclusion of clause 10. [This clause is exactly the same as clause 12 of the Cardiff Bill—see "JOURNAL," last week, p. 488.]

Mr. CHARTERIS said that if the Committee had any doubt, he would suggest that they ask the Board of Trade whether they would be able to deal with the matter. At the same time, he was perfectly willing to fight the case before the Committee.

In reply to questions by Mr. Hopkins, Mr. CLODE said he objected to the matter being referred to the Board of Trade, on the ground that the decision would be delayed indefinitely.

The CHAIRMAN decided that evidence should be heard with regard to finance and the basic price; and the Committee would then decide whether they would fix the price or refer it to the Board of Trade.

Mr. *E. H. Leader* (a Director of the Company) said it was originally intended to construct works near the existing works of the Company; but the scheme had been abandoned in 1914 in favour of a new site, which had been acquired for the purpose. Just before the war, something like £40,372 had been spent in this connection. The war had put a stop to further developments; so that since then the capital had been lying idle, without any return being realized. They had great difficulty in carrying on with their existing works, which could only be kept going by uneconomical patchwork. In addition, the engineer had reported that he could no longer accept responsibility for the carrying on of the work. In 1919, the Company had arranged for an overdraft from the bankers to continue the erection of works; but they were unable to proceed owing to the increased cost of materials—the fact that they could only get provisional prices quoted, and so on. In 1920, however, when these difficulties were removed, the bankers had refused to carry-out the arrangement with regard to the overdraft; so that the Company had been living from hand to mouth. The bankers were now pressing the Company to liquidate the overdraft already existing. The Company were absolutely unable to meet the anticipated demand without the new works, and, therefore, they were determined to carry out as soon as possible the policy, or a portion of the policy, they set themselves in 1914. A Special Order had been granted by the Board of Trade under section 10 of the Gas Regulation Act authorizing the Company to create and issue redeemable or irredeemable debenture stocks or bonds for £199,400; this being, with the amount already borrowed, half the Company's authorized capital. The application now before the Board of Trade was made so that they could again pay the 5 p.ct. dividend. If the matter were delayed so long that they were unable to get the basic price settled in time to charge the consumers at the end of the next meter readings, obviously they would not be able to get the basic price into force until next year, which would be a serious thing, seeing that they were already working at a loss. The capital which the Company would be empowered to raise, if the financial provisions of the Bill were granted, would be reduced to something like £598,005 after the overdraft to the bankers had been liquidated; and the engineer had advised them that this was only sufficient to meet his estimate for the provision of new works and distributing mains which were absolutely necessary at the present moment. Contracts for the work must be entered into directly the Bill received the Royal Assent. It was necessary that the ordinary capital should be issued at once; and the Bill, if passed, would help considerably to raise the capital.

Mr. CHARTERIS, cross-examining, pointed out that in the application to the Board of Trade the maximum price asked for was 2s. 2·7d. per therm. In the Bill as deposited, the basic price was 1s. 11¾d.—this again was altered to 1s. 8d., and finally to 1s. 7·8d.

Witness replied that this was due to variations in the prices of materials.

Mr. CHARTERIS said that before the war the price actually charged within the borough was 2s. 8d. per 1000 c.ft., and under the Bill they proposed to charge an equivalent of 7s. 6d. per 1000 c.ft. This was very high, compared with the price charged by other undertakings throughout the Kingdom.

Witness replied that some other companies were charging a higher price.

In re-examination, witness agreed that the proposed charge for gas had fallen as materials were reduced in price, in order that it should be as fair as possible.

The CHAIRMAN pointed out that the Board of Trade had power to revise the decision immediately if application were made, assuming that the Committee did fix the price.

Mr. HARKER at this point informed the Committee that the petitions of other railway companies would be fought-out on the petition of the Great Western Railway Company.

Mr. *E. Ablett* (Assistant Engineer and Secretary to the Company) then gave evidence. It being intimated by the Chairman that the Committee particularly wanted to know why there was such an enormous difference in the price as compared with towns in the immediate neighbourhood, witness said that the costs of manufacture came to 77·30d. per 1000 c.ft., from which were deducted meter-rents and other charges, amounting to 6·89d., reducing the figure to 70·41d. The capital charges also had to be added, as had been stated by the previous witness. These were based on a dividend of 5 p.ct. on the old stock and 8 p.ct. on the new. [The Bill originally asked for 6 p.ct. on the old capital; but in view of the decision in the Cardiff case, the Committee were asked to grant the 5 p.ct.]

The CHAIRMAN asked why 8 p.ct. should be asked for the new capital.

Witness said that the Swansea case was considered to be more urgent.

Mr. CHARTERIS contended that it should be governed by the Cardiff decision.

Witness, in reply to Mr. Charteris, said that the decreased dividend from 8 to 7 p.ct. would make a difference of only 0·2d. per 1000 c.ft. in the price of gas—*i.e.*, it would only be reduced to 7s. 5d. per 1000 c.ft.

It was pointed out for the promoters that in the Cardiff case they were improving the works and adding to their productiveness, while in Swansea the new works would be unproductive for some considerable time, and they would have to bear the capital charge without anything coming in in respect of the capital expended. They were spending £156,000 on distributing services alone.

Cross-examined by Mr. CHARTERIS on the reduction of the basic price, witness said a contributing factor was the elimination of a figure of £10,000 in respect of deferred repairs and maintenance from the schedule presented to the Board of Trade in support of the application under the Gas Regulation Act. Also, £8000 in respect of deferred repairs and maintenance of distribution and service pipes had been eliminated.

Mr. CHARTERIS said the schedule presented to the Board showed an item of £50,000 for repairs and maintenance of works and plant, which, deducting the £10,000 referred to, left £40,000, while the average for 1912-13-14 was £7044.

Witness said the figure of £7044 was in respect of normal maintenance, and was not in respect of neglect during the war. The amount spent on repairs and maintenance in 1920 was £37,986.

The CHAIRMAN said this ought to lessen the amount required in the years following.

Mr. CHARTERIS said that was exactly one of his points.

Witness could not say how much of this amount was in respect of deferred repairs.

The Committee then conferred with Sir Ernest Moon, K.C. (the Speaker's Counsel), on the question of whether or no the question of basic price should be left to the Board of Trade; and it was announced

that a representative of the Board of Trade would attend. As to the delay which might ensue, the Chairman pointed out to Mr. Clode that the Bill was a House of Commons Bill, which, when passed, would have to go through the House of Lords, and then receive Royal Assent; so that the question of loss of time would make very little difference.

Mr. Charteris, continuing his cross-examination, said that, in view of the fact that the price paid for coal in Swansea was less than that paid in Cardiff during previous years, it would be well to know why, in the estimate for 1921, it was something like 4s. more?

Witness replied that they had to try to level-up notoriously bad coal round about them by coal from greater distances. This did not apply so much to Cardiff, because they were nearer the English border. He did not know the Cardiff figures, however.

Counsel said that, in addition to the difference in the price of coal, the make per ton in Swansea for 1921 was estimated at 9857 c.ft. of 450 B.Th.U. gas, whereas the corresponding make in Cardiff was 11,003 c.ft.

Witness said that the estimate for coal included the cost of conveying it to the retort-house, which was difficult owing to the congestion at the works.

Further, dealing with the estimate for oil, which was £20,000, Counsel said that it was unnecessary to use oil at all in order to produce gas of 450 B.Th.U. Witness having given the value of coal gas produced at Swansea at 540 B.Th.U., and carburetted water gas at 400 to 450 B.Th.U., Counsel said that, by taking 70 p.ct. of coal gas and 30 p.ct. of carburetted water gas, which was the proportion calculated to be manufactured, they would arrive at a mixture of 505 B.Th.U. The value of blue water gas was 300 B.Th.U.; so that with percentages of 70 and 30 the result would be a mixture of 465 B.Th.U., which was 15 B.Th.U. more than that budgeted for in the Bill, without the use of oil, and would enable the price of gas to be reduced. Assuming, however, that oil was required, the prices were changing very rapidly. The price was higher than that budgeted for in the Cardiff case, which witness attributed to the fact that there were better facilities for obtaining it in Cardiff. Mr. Charteris said he was informed, however, that the Anglo-Persian Oil Company had opened an enormous depot at Swansea, so that there were facilities as good as in Cardiff.

Witness said they would have, but that had not been allowed for in the schedule.

Dealing with residuals, it was said that there had been a reduction in receipts from this source. Counsel pointed to the estimated receipts from the sale of coke, which were based on a figure of 31s. per ton in Swansea in 1921, while Cardiff had estimated 47s. per ton.

At this point, the Committee conferred privately with the representative of the Board of Trade, after which

The Chairman announced that the Committee had decided to put a clause in the Bill leaving the fixing of the basic price to the Board of Trade. He was sure they were doing the best thing for all parties concerned. The whole thing was most complicated, and would be very difficult, especially having regard to the very rapid changes that were taking place.

Mr. Clode asked if the Chairman could say when the Board would deal with the matter.

The Chairman again assured Mr. Clode that he did not think the matter would be delayed in the smallest degree.

The only question outstanding was that of pressure; and after the luncheon interval the promoters submitted a clause calculated to meet the railway companies on this point. The clause provided that if, after the passing of the Act, any railway company who were consumers of the Company applied to the Board of Trade to reduce or increase the prescribed pressure, the Board should have power to make the necessary alteration in any part of the area. It should be pointed out that the prescribed pressure, as laid down in new clause *7a*, is the same as in the case of Cardiff—namely, a minimum of 2½ in. if the calorific value is below 350 and not below 300 B.Th.U.; and, if below 300 B.Th.U. it is to be prescribed by the Gas Referees, but must not be less than 3 in. A proviso is also added to the clause to the effect that the minimum permissible pressure shall not apply as regards the supply of gas in certain districts until the Company have installed a system of high-pressure feeder mains to enable the supply to be given at such minimum permissible pressure.

The clause was agreed to in principle; but Mr. Harker said that it was subject to small drafting amendments. This would also involve alterations to clause *7a*.

Further discussion then took place with regard to the basic dividend on the new stock of the Company, Mr. Szlumper pointing out that the Company attached great importance to the 8 p.ct., and suggested that Mr. Leader might give evidence again on this point.

The Chairman said it would be difficult to grant 8 p.ct. to the Swansea Company when they had only granted Cardiff 7 p.ct. the previous week. The Cardiff Company were down on their knees.

Mr. Szlumper said the Swansea Company had gone below their knees, and were worn-out completely. A gas company might come before the Committee which could not possibly raise capital under 10 p.ct., and the Committee could not look back to Cardiff as the only case that could be referred to.

The Chairman said he looked upon the Cardiff and Swansea Companies as being two concerns in very similar districts.

Mr. *E. H. Leader*, giving evidence, said that unless the Company utilized a portion of the £199,000 debenture stock granted by the Board of Trade as a high-speed Order they were absolutely obliged to issue capital. The point was the price at which they would have to issue the debenture stock; and experience had shown that other companies who had issued debenture stock had to do so at 7½ p.ct. He gave instances of other large and flourishing concerns which had issued debentures at 7 and 8 p.ct., and, having regard to the facts, they had come to the conclusion that if they had to issue their ordinary stock at 7 p.ct. they would have to do so at about 10 p.ct. discount.

The Chairman said that if they were going to issue debentures at these prices, what was the use of having ordinary stock at 7 and 8 p.ct.? Was there any possibility of paying a dividend on it at all? The Committee were anxious to avoid fixing the rates too high, and so placing the Company in a difficult position.

Mr. Szlumper pointed out that it was only for five years.

The Chairman said it seemed to him that the Company would have to face a much worse position later if high rates were granted.

Mr. Charteris, in cross-examination, said the examples quoted by the witness were issues during the last twelve months, when the bank rate was 7 p.ct.; but the bank rate had changed since then. In the case of the debentures, there was no inducement to the investors with regard to the upward slide.

Witness said he was afraid the investor would have to be satisfied that there was going to be a tangible result from the upward slide before he would take that into account; so that until the Company could put it into operation he did not think it would have much effect upon the market. In reply to a further question, he stated that the Company's stock now stood at 63.

The Chairman announced that the Committee saw no reason to change the figure from 7 p.ct. The decision on the Cardiff Bill governed the Swansea Bill, except with regard to basic price; and he had still to agree a clause that this was to be fixed by the Board of Trade.

Mr. Charteris asked whether the Swansea Corporation retained a right to challenge whether there should be a basic price or not.

The Chairman said they did.

The Bill is substantially the same as that promoted by the Cardiff Company. The same new clauses have been inserted as regards notice as to alteration of declared calorific value; alteration, adjustment, and replacement of burners; and the section of the Bill dealing with declared calorific value being deemed an Order of the Board of Trade under the Gas Regulation Act.

BATLEY CORPORATION BILL.

This Bill was considered by Section A of the Local Legislation Committee of the House of Commons last week—presided over by Sir William Middlebrook.

Part IV. of the Bill provides for additional powers for the gas undertaking of the Corporation. The usual clauses are inserted to give power to purchase, sell, let on hire, fix, repair and remove fittings, &c. (but not to manufacture them); to enter premises and remove fittings; to lay pipes in private streets; to lay pipes for ancillary purposes; to vary the price according to purposes for which gas is supplied; and for various other purposes provided by the Model Bill.

Mr. *Rudolph Hyde Duxbury* (the Gas Engineer to the Corporation) supported the proposals of the Corporation. With regard to clause 62, which gives authority to supply by agreement power gas which shall not be required to comply with the provisions of the Acts of the Corporation as to illuminating power, calorific value, purity, or pressure, he said the Corporation would be in a position, when alterations were made, to take in hand this supply. There was a great amount of power used in Batley for which this type of gas would be extremely useful, if the Corporation were able to provide it. Consequential clauses are also included dealing with conditions as to quality of power gas supplied, and giving the Home Secretary authority to make regulations as to its supply. A new clause has also been inserted for the protection of the London and North-Western Railway Company.

With regard to the financial powers, the Corporation were asking for £100,000 borrowing powers for the general purposes of the gas undertaking—this amount to be chargeable to the gas revenue and the borough fund and borough rate, and repayable in thirty years. Substantially, the works as they existed up till quite recently were the works as originally built, and it was found necessary to improve them, to instal a new class of retort, &c. But for the intervention of the war, this would already have been done. As a matter of fact, said witness, the need was so urgent that the Corporation had to anticipate statutory borrowing powers in order to provide adequately for their needs; and improvements had been paid for out of revenue. Otherwise they could not have fulfilled their obligations as gas undertakers. They had entered into a contract for the installation of vertical retorts, the total cost of which would be £79,944. The contract price for the carburetted water-gas plant was £10,000; and for the ammonia water and tar extractor, £3000. The work in connection with the boiler-house, and the chimney work necessary, were being done by direct labour, at a cost of £3000—£1635 being in respect of wages, and £1365 in respect of materials. The price quoted for the boilers was £4300; and the total expenditure on the works was £100,244. The actual figure had been ascertained since the Bill was deposited; and had the Corporation known that the cost would be so great, they would have asked for higher borrowing powers. It was originally intended that, if borrowing powers of £100,000 were granted, after providing for improvements in the works there should be a margin of £10,000. But owing to the increased cost this margin had already been exceeded. The alteration to the works would enable them very materially to reduce the cost of manufacturing gas beyond the sinking fund and interest charges that would have to be met on the expenditure; so that in a year or two they would be able to deal with the accumulated deficits of the war period, and later reduce the price of gas.

The Chairman pointed out that in the accounts to March 31, 1920, there was a balance of capital expenditure in excess of loan capital; and he asked how it was proposed to deal with this. Was there any deficiency of revenue included in the figures?

Mr. Jeeves said the point was that they must have borrowing powers for the amount, which was £8158. It had so far been dealt with by overdraft from the bank, and had to be met. There was no deficiency of revenue included in the amount.

The Chairman suggested that the borrowing powers might be increased to £110,000; but it being pointed out that a margin of £10,000 had previously been estimated, the Committee raised the figure to £120,000. It was stated that to increase the borrowing powers above the amount asked for was not a usual proceeding; but it was thought the undertaking should be put on a satisfactory financial basis.

MISCELLANEOUS NEWS.

BOARD OF TRADE INERTS COMMITTEE.

What is understood to be the final meeting of the Committee appointed by the Board of Trade under the Gas Regulation Act, to inquire into the incombustible constituents of gas, was held on Wednesday last, June 1, when evidence was heard from Mr. GEORGE HELPS, of Nuneaton, and Professor R. V. WHEELER, of Sheffield. Mr. J. HUNTER GRAY, K.C., was in the chair; and the other two members of the Committee, Mr. Butterfield and Dr. Lander, were present.

Mr. HELPS had previously sent the Committee a long statement, accompanied by several tables, which are given below.

PRECIS OF MR. GEORGE HELPS'S EVIDENCE.

I have been making and using gas for 35 years, and am also concerned as a contractor and engineer for high-pressure distribution. As an experimentalist for 10 years, I have devoted nearly the whole of my time to the production of cheap gas.

If coal is taken as the main source of heat and power, then gas in a cheap form is as important as cheap coal. Losses by ordinary complete gasification are 22 to 25 p.ct.—chiefly due to radiation and the loss due to cooling of gas. The temperature obtainable with hot producer gas is no more than with the cold gas reheated—a question of cost. The whole question of the use of low-grade gas becomes one of temperature obtainable and stability of flame.

The main object of my evidence is to show that, if all restrictions are removed, 20,000,000 heat units are obtainable from a ton of coal saleable at one-half to one-third of present prices in qualities of gas with restricted inerts. Gas without restrictions is saleable at about the same price as coal—heat for heat.

A ton of coal contains (say) 30,000,000 heat units, and costs £2. Gas of 550 B.Th.U., containing 30,000,000 heat units, is selling in London to-day for £15 (1s. a therm). Something is wrong with the process of manufacture or control, or both, when seven times as much is charged for coal in the gaseous as in the solid form. The question of combustibles is bound-up with the question whether gas of 550 B.Th.U. or gas of about 300 B.Th.U. shall be sold. Heat units are more cheaply made in rich gas with low inerts than in a poor gas with low inerts. The cheapest system of gas manufacture is that which will produce and deliver to the consumer from a ton of coal the greatest number of heat units in a quality fulfilling his requirements.

In the light of present knowledge, a system of complete gasification in closed vessels without chimneys appears to be the system to be adopted, or something very akin to it. Such a gas is bound to contain high inerts, CO_2 and N_2. The former, of course, is removable. The question of the lowest quality which will fulfil all the requirements of the domestic user can only be found by practice on a large scale, and practice alone. I am satisfied that 300 B.Th.U. gas is quite all right for him. I may go lower. I have experimented with lower qualities. A low-quality gas with inerts will not necessarily add to the costs of distribution.

I am interested in low-grade gas generally, however manufactured. I admit the responsibility for the proposition that, in the majority of uses to which it is put, gas of about 500 to 550 B.Th.U. gross, supplied at ordinary low pressures as hitherto, will do no more work, volume for volume, than a gas of about 350 to 400 B.Th.U. gross supplied at the same pressures. As this may be considered controversial, I will state it in another way, and say that, if with 500 B.Th.U. gas 150 B.Th.U. or so are undeveloped in the flame, then the heat obtained from a gas of 350 B.Th.U. in which every B.Th.U. is developed, would be equal to the developed B.Th.U. of the 500 B.Th.U. gas.

The temperature of a flame depends largely on the degree of primary aëration or complete combustion in one stage. Gas of 550 B.Th.U. or so is more trouble to make and more trouble to use than lower-grade gas. Nitrogen is not altogether a mere adulterant. It provides the power for the injection of the air necessary for the gaseous combustibles, and so allows of a low pressure at the nipple—an important matter in distribution.

Suggested Principles for Guidance.

From the foregoing general treatment of the subject, the following notes may be considered as a basis for governing with more or less definiteness a closer inquiry into the question as to what extent inerts in gas are detrimental.

Inerts and Quality.

A low-quality gas, say 300 blue water gas, need not contain high inerts; but speaking generally, low-grade gas means a gas having a high inert content.

Complete Gasification.

By the term "complete gasification" is meant the gasification of coal in closed vessels without chimneys or provision deliberately to allow heat units as generated to be dissipated into the atmosphere.

[Water-gas making involves the use of a chimney or stack-pipe through which the blow passes, and also a chimney in connection with the boilers used for the production of the steam required for the generator and blower, and is thus only a partial gasification process.]

Degree in Combustion—Its Stages—Flame Temperature.

In comparing the heating efficiencies or flame temperatures of gases of different qualities or compositions, each gas to be compared should be used in a manner which ensures the same degree of combustion taking place in each case. This degree, in my view, should be complete combustion in one stage. Calculations for the discharge of gas through any main system should be made on the completely combustible mixtures of such gas, and not the gas alone.

[Here show Beckton 48-in. main as a nipple to a bunsen burner.]

Discharge of B.Th.U. in Different Qualities.

The quantity of gas distributed through a system of main pipes depends on the volume of gas, *plus* the volume of air required for its complete combustion.

A gas of 500 to 600 B.Th.U. requires (say) 5 vols. of air.

A gas of 300 B.Th.U. requires (say) 3 vols. of air.

The pressure required with 500 to 600 B.Th.U. gas to inject 5 vols. is about 25-10ths. The pressure required with 300 B.Th.U. gas is about 5-10ths. Here, then, is a compensating influence set up in the case of low-grade gas.

[Here show gas and air required by volume with 550 B.Th.U. gas in Beckton main; also show weights of such gas and air.]

The Cost of Gas.

The cost of gas to the consumer depends on:

1.—The cost of coal, less residuals.
2.—The original cost of plant used to make it, *plus* the upkeep and maintenance of such plant.
3.—The cost of labour for manufacturing it.
4.—The cost of distributing it through main pipes, including the up-keep of main pipes, all labour, &c.
5.—The standing charges, including management, profit, office expenses, income-tax, &c.
6.—The amount of free work done.
7.—Leakage and used on works.

The service the consumer gets depends on:

1.—The gas he receives.
2.—The manner and method of use, whether it be correct or otherwise, and the kind of appliance. [In my view complete combustion in one stage should be applied, or something very near it, and a fixed nipple—adjustable nipples are an abomination.]

For the conservation of coal, the chief factor is the greatest production of B.Th.U. or therms from a ton of coal.

For the Consumer of Gas.

For the consumer of gas, the chief factors are:

1.—The number of B.Th.U. or therms he obtains for his money.
2.—The service he obtains per unit of B.Th.U. or therms in direct use as they are supplied to him.
3.—The service he may obtain, and cost of same, if he carburets or otherwise improve the gas for any particular service.

The main issue will probably be found to be economy in the use of coal consistent with the consumer having served to him at the necessary regular pressure a gaseous fuel suitable to his requirements at the lowest cost. As I understand it, coal and gas are interchangeable terms. If it be assumed that coal is the chief item in the cost of gas, then its conservation must be identical with cheap gas—*i.e.*, low-grade gas with high inerts.

NOTE.—Coal is not the chief item of cost when coal is carbonized in retorts and rich gas made together with 10 cwt. of coke and various bye-products. This is coke and bye-product making, not gas making. The price of coke or bye-products might entirely wipe-out coal costs. Then gas could be sold so cheaply that no coke would be required; and this is the undoing factor in the present coke-making system.

The only fundamental principle so far as the making of cheap gas is concerned, may then be stated as involving the simplest, and therefore least costly (in capital), plant that will produce the greatest number of heat units from a ton of coal in a quality of gas suitable for the service the consumer requires.

Principles Concerned in Distribution.

The principles concerned in the distribution of gas, and which may affect the question of quality and composition and thus the manufacture, are:

1.—The lower a gas in calorific value, the greater the space occupied by a given unit of B.Th.U. in the mains, &c.
2.—The higher the calorific value, the less the space occupied by a given unit of B.Th.U. in the mains, &c.
3.—The lower the quality, the less the volume of air required to be injected by the nipple, and thus the less pressure required at the point of consumption.
4.—The higher the quality, the greater the volume of air required to be injected at the nipple, and thus the greater the pressure required at the point of consumption.
5.—The degree of aëration that burners should give and the degree of flame-contact.

So that it is at once seen from principles Nos. 3 and 4, that the costs of distribution are not proportional to the space occupied by a unit of B.Th.U. in the mains.

It is now admitted that a rich gas of 550 B.Th.U. or so is much more troublesome in use to obtain anything like full duty from it. There is no doubt about this.

I am of opinion that, given a gas of 300 to 200 B.Th.U., or even less, containing 50 p.ct. or so of N_2 delivered to the domestic consumer's appliances in sufficient volumes, he would obtain all the service from it he has hitherto obtained, B.Th.U. for B.Th.U, and, indeed, in many uses a far better service.

Uses of Gas.

The use to which town gas is put to-day are manifold; but so far as the domestic consumer is concerned, they are probably covered by:

1.—*Lighting.*—Directly by gas in flat-flames or incandescent burners or gas-generated electricity.
2.—*Cooking.*—In gas-heated ovens and with ring burners, hot-plates, &c.
3.—*Gas-Fires.*—For heating apartments, &c,
4.—*Water Heating.*—In geysers, boilers, &c.

The industrial user requires gas for power and all sorts of heating purposes such as:

5.—*Gas-Engines.*—For power and electric light.
6.—*Gas Lighting.*—By incandescent mantles and flat-flames.

7.—*Muffles and Furnaces* of all kinds for melting metals, blow-pipe work, &c.

So far as the domestic consumer is concerned, his only use that requires a high flame temperature is lighting. With all the other uses, however low the flame temperature the difference between the heat of the flame (with any gas likely to be distributed) and the heat required is so great that he is at no disadvantage. Indeed, he will obtain with 300 B.Th.U. gas and less having 40 to 50 p.ct. inerts in the form of N_2, rather better average efficiencies than he does with 500 B.Th.U. gas as at present supplied.

Lighting.

For flat-flame lighting with 300 to 200 B.Th.U. gas, it will be necessary for the consumer to enrich a non-flat-flame gas with benzole or such like. For incandescent lighting with gas of 300 B.Th.U. or thereabouts, he will require (say) 20 p.ct. more heat units than with a 500 B.Th.U. gas. But even here this calculation is based on the maintenance of the maximum light continually, and not the average light that an incandescent burner gives with a rich gas and a mantle. No consideration of maintainable light from an incandescent burner is complete that does not take into account the average condition of the mantle and the average manner in which both burners and mantles are maintained. The deterioration of the mantle makes more than 20 p.ct. difference on the light, to say nothing of the effects of holes, &c., in mantles.

It has been argued before you by the railway companies (Mr. W. C. Goodchild) that gas with increased inerts in a "C" burner very materially reduces the efficiency. Mr. Goodchild referred to the Institution of Gas Engineer's Investigation Committee's report. I understand that it was stated by a witness that, with gas of 385 B.Th.U. gross (made up of coal gas and blue water gas with low inert content), only 11 p.ct. more heat units were added; whereas with coal gas and nitrogen of 385 B.Th.U. containing about 41 p.ct. of inerts, 50 p.ct. additional heat units would be required to maintain the same illumination on the mantle. If my information is correct, I would ask what quantity or percentage of increase in heat units is required to maintain any illumination at all when gas is of 300 B.Th.U. and contains 50 p.ct. inerts, such as that which has been supplied to the railways in Nuneaton?

I put in the consumption of gas for the last eleven years in Nuneaton by the London and North Western and Midland Railway Companies.

for them by the enrichment of gas of 300 B.Th.U. or so on their own premises such enrichment being done by them or by the gas undertaking. Or, better still, they could put down a gas-engine and generate their own electricity at a cost of something like 2d. to 3d. per unit.

I would submit that, if it can be proved that a low-grade gas is cheaper and better for domestic users than a rich gas, such consumers should not be saddled with the increased cost of a rich gas because railways or any industrial users desired, or thought that they required, a more expensive quality.

The industrial user who requires a higher flame temperature than a low-grade gas with high inerts could give him, may very well afford to enrich such gas on his own premises. The enrichment might take several forms. Gas-flames are produced by carburetted air. The combustibles in a completely combustible mixture of gas and air occupy from about 14 to 28 p.ct. of the volume or space occupied by the whole mixture that issues at the burner-head.

The following are methods of increasing flame temperature to be adopted by large users of gas and others:

1.—Enrichment by adding B.Th.U. on consumer's premises for those uses requiring it by
- (*a*) Benzole, petrol, or even heavy oil.
- (*b*) By carbonizing gas or cannel coal in cast iron or other retorts. By carbonizing or gasifying oil.
- (*c*) By making blue water gas.

Note.—The advantage of making the enrichment on the consumer's premises is that so doing would save the cost of added heat units for producing a higher flame temperature than was required.

2.—Increasing flame temperature.
- (*a*) By passing cold low-grade gas through a hot coke or fuel bed, and so adding a sensible heat to it.
- (*b*) By preheating the gas or the air or both by passing same through heaters or regenerators.
- (*c*) By removing some of the N_2 in the low-grade gas.

There are means other than those to be adopted; and the scope for inventors and others is great. Any or all of these processes could be carried out for the large user or a particular district by the gas undertaking, if the user wished it—so long as he paid for such service.

London and North Western Railway Consumption.

—	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.
Mineral office	—	—	8,900	20,200	23,700	14,900	15,100	13,400	14,300	9,200
" "	—	—	15,300	23,000	35,900	34,200	31,900	24,800	12,600	5,300
Goods shed	318,800	241,400	288,100	264,400	268,700	340,400	322,700	367,900	243,000	184,300
Station lighting	2,722,700	2,625,800	3,103,700	2,764,500	2,673,000	2,018,500	1,537,300	1,555,500	1,689,900	1,789,600
Signals	1,596,400	1,844,700	1,849,400	1,345,600	1,636,500	1,620,300	1,834,100	1,862,400	1,888,600	1,982,700
"	377,900	534,700	284,100	138,300	148,800	188,500	132,600	132,300	176,100	216,200
Locomotive sheds	1,320,100	1,476,300	1,709,500	1,742,400	1,615,700	1,621,800	1,410,300	1,538,100	1,615,000	1,607,300
Refreshment department	—	—	—	—	230,700	718,100	689,900	778,000	1,066,300	1,287,200
Engine	137,700	77,400	91,700	60,000	72,000	14,000	5,500	700	1,600	18,200
	6,473,600	6,790,300	7,350,700	6,358,400	6,705,000	6,570,700	5,979,400	6,273,100	6,707,400	7,060,000

Midland Railway Consumption.

—	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.
Nuneaton	782,600	1,153,600	1,161,300	1,013,900	1,060,000	881,900	796,200	684,600	632,200	717,800
Stockingford	2,202,600	1,852,500	2,286,200	2,021,800	1,728,900	1,263,400	1,314,800	1,275,400	1,329,800	1,449,400
	2,985,200	3,005,900	3,447,500	3,035,700	2,788,900	2,145,300	2,111,000	1,960,000	1,962,000	2,167,200

How is the reduction in consumption accounted for? In my view—and, if doubted, it could be proved—mantles cause more loss than inerts. Where is there a railway station with perfect mantles? Many stations will not average one sound mantle in three; and what effect has this on the illuminating power?

Again, all the data used in considering the value of low-grade gas—high N_2 content—is considered as used in existing burners which have been designed for high grade—say, 550 B.Th.U. gas. If a burner were specially designed for low-grade gas, together with a mantle to suit it, I rather fancy the results would be quite different. Our experience with the station lighting at Nuneaton is that the difference in the size of mantle used varies from 30 to 50 p.ct., and yet the same size of flame is supplied to each. These are practical considerations. The flame has not been fitted to the mantles, neither has the mantle been fitted to the flame.

The railways ask for restrictions of inerts in gas of 450 and 500 B.Th.U.!! I would submit that they cannot have based their request on experience with a regular quality of low-grade gas. Nor can they have considered the fact that, with really low-grade gas, the B.Th.U. will cost them less than half the money they cost in the rich gas they are asking for—probably only one-third of such cost. Again, the richer the gas the more readily is the burner put out of adjustment by variations either in quality or pressure. The railway companies are aware of this.

The railway companies seized on the report of the Institution of Gas Engineers Investigation Committee; but I would submit that the investigation made was not carried out on correct lines. The nipples should have been adjusted, and then a mantle fitted to the flame.

I am unable to accept that, in the average of cases, anything like 20 p.ct. increase in B.Th.U. with a 300 B.Th.U. gas would be necessary, much less a 50 p.ct. increase. I should like to show the Committee burners and mantles supplied with 300 B.Th.U. gas containing nearly 50 p.ct. N_2, if the members of the Committee will give me an opportunity to do so.

In connection with the attitude of the railways, I would submit that, even if they required a specially rich gas, it could be provided

Almost ever since town gas has been distributed it has been too rich for most of the uses to which it has been applied; and the time has surely come when a less rich, and therefore cheaper, gas may be supplied for the majority of purposes, and any particular purpose left to the consumer's own devices.

The Largest Industrial User Should Make His own Gas.

I submit that the really large user cannot afford to buy from the gas undertaking, unless he happens to be quite close to a gas-works station. In such a case, the mains could be laid direct from the works to his factory. Even then the continuous user could save money by becoming his own producer. For intermittent uses by consumers a distance away from a gas station, the gas undertaking might be able to supply as cheaply; but it would be a near thing for quantities.

Town Gas-Works Mainly for Domestic Consumers and Comparatively Small Industrial Users.

It is submitted that town gas-works are mainly for the domestic consumer and the comparatively small industrial user. If there are no restrictions, low-grade gas will be supplied at a price very near that of the cost of coal, heat for heat. Domestic consumers, if supplied with three times the gas for the same money, will use gas to the exclusion of coal, which is a very desirable thing for the health of the people and the beauty of the landscape, as well as for conservation of coal.

I need not trouble you with the various methods of gas production in use to-day. The Committee are familiar with them.

The cost sheets of the Gas Light and Coke Company, the South Metropolitan Gas Company, and the Nuneaton Gas Company—see pp. 563-4—speak for themselves as to how I propose to give the consumers three times the B.Th.U. for the same money.

In conclusion, I trust that the evidence the Committee have taken will prove convincing as to the fact that the requirements of all classes of consumers can be met, irrespective of cost, just as satisfactorily with a gas containing high inerts as with one containing only a low

GAS LIGHT AND COKE COMPANY—PRESENT PRACTICE.

Gas sold, 31,963,543,000 c.ft. B.Th.U. sold, 15,342,500,640,000. Tons of coal used, 2,891,819 tons, making 5,300,000 B.Th.U. per ton.

Divisor.	Amount.	Per Ton of Coal Gasified. 2,891,819.	Per Therm 100,000 B.Th.U. 153,425,600.	Per 1000 C.Ft. of Gas Sold. 31,963,543.	Per H.P. of 10,000 B.Th.U. 1,534,256,000.
	£	Shillings.	Pence.	Pence.	Pence.
Manufacture of gas—					
Cost of 2,279,253 tons of coal, *plus* 612,566 tons added for CWG = 2,891,819 tons, including expenses	5,318,863	..	..	..	..
Coke, &c., used in manufacture of CWG	335,167	..	..	..	..
Oil, including all expenses thereon	215,823	..	..	..	..
	5,869,853	40·59	9·19	44·07	0·919
Less Residuals	4,839,214	33·46	7·57	36·33	0·757
Total cost of coal, oil, coke, less residuals	1,030,639	7·13	1·62	7·74	1·162
Purification	75,098	0·52	0·11	0·56	0·011
Engineers at works	65,435	0·45	0·10	0·49	0·010
Wages	662,502	4·58	1·04	4·97	0·104
Repairs and maintenances, works and plant, less received for old material, £37,601	2,247,598	15·54	3·51	16·88	0·351
Total manufacturing cost	4,081,272	28·22	6·38	30·64	0·638
Distribution of gas—					
Salaries of officers and clerks	315,392	2·18	0·49	2·37	0·049
Repairs and maintenance of mains and services.	596,308	4·13	0·94	4·48	0·094
To management	280,028	1·94	0·44	2·10	0·044
Rents, rates, and taxes	590,346	4·08	0·92	4·44	0·092
Co-partnership	42,877	0·29	0·07	0·32	0·007
Parliamentary, bad debts, depreciation fund	9,114	0·07	0·01	0·06	0·001
Annuities to officers	116,670	0·81	0·19	0·88	0·019
Workmen's compensation	7,798	0·05	0·01	0·06	0·001
National insurance	16,306	0·11	0·02	0·12	0·002
Public officers, &c..	3,639	0·02	0·01	0·03	0·001
	£6,059,750	41·90	9·48	45·50	0·948

GAS LIGHT AND COKE COMPANY—PROPOSED PRACTICE.

How three times the heat energy—B.Th.U.—may be sold for the same money.
B.Th.U. required . . . 46,027,501,920,000.
Gas to be sold, cubic feet . $\frac{46,027,501,920,000}{\text{B.Th.U. per foot.}}$
Tons of coal required . . 2,301,370 tons; making 20,000,000 B.Th.U. per ton.

Divisor.	Amount.	Per Ton of Coal Gasified. 2,301,370	Per Therm 100,000 B.Th.U. 460,275,019	Per 1000 C.Ft. Gas Sold.	Per H.P. of 10,000 B.Th.U. 4,602,750,192
	£	Shillings.	Pence.	Pence.	Pence.
Manufacture of gas—					
Cost of 2,301,370 tons of coal, including oil and coke used in the manufacture of CWG at 40·59s. per ton at make of 20,000,000 B.Th.U. per ton	4,670,630	40·59	2·43	..	0·243
Less residuals	1,027,479	8·93	0·53	..	0·053
Total cost of coal, oil, coke, *less* residuals	3,643,151	31·66	1·90	..	0·190
Engineers at works	65,435	0·57	0·03	..	0·003
Wages	165,625	1·44	0·09	..	0·009
Repairs and maintenance of works and plant, *less* received for old material	749,199	6·51	0·39	..	0·039
	4,623,410	40·18	2·41	..	0·241
Distribution of gas—					
Salaries of officers, engineers, and clerks	315,392	2·74	0·16	..	0·016
Repairs and maintenance of mains and services.	596,308	5·18	0·31	..	0·031
Management	280,028	2·43	0·15	..	0·015
Rent and rates	590,346	5·13	0·31	..	0·031
Annuities, bad debts, National Insurance, law and parliamentary charges, &c.	196,404	1·71	0·10	..	0·010
	£6,601,888	57·37	3·44	..	0·344

SOUTH METROPOLITAN GAS COMPANY—PRESENT PRACTICE.

Gas sold, 14,343,417,000 c.ft. B.Th.U. sold, 7,888,879,350,000. Tons coal used, 1,211,857. B.Th.U. per ton, 6,500,000.

Divisor.	Amount.	Per Ton of Coal Gasified. 1,211,857.	Per Therm 100,000 B.Th.U. 78,888,793.	Per 1000 C.Ft. Gas Sold. 14,343,417.	Per H.P. of 10,000 B.Th.U. 788,887,935.
	£	Shillings.	Pence.	Pence.	Pence.
Manufacture of gas—					
Cost of 1,211,857 tons of coal into store, including £868,300 for London port dues	2,344,970	38·70	7·13	39·24	0·713
Less residual products	2,143,340	35·37	6·51	35·86	0·651
Total cost of coal, *less* residuals	201,630	3·33	0·62	3·38	0·062
Purifying	79,005	1·30	0·24	1·32	0·024
Engineers at works	99,977	1·65	0·30	1·67	0·030
Wages, carbonizing	259,946	4·29	0·79	4·35	0·079
Repairs and maintenance of works and plant, *less* £18,738 received for old material	892,053	14·72	2·71	14·93	0·271
Total manufacturing cost	1,532,611	25·29	4·66	25·65	0·466
Distribution of gas—					
Salaries of engineers, including clerks	124,011	2·04	0·38	2·08	0·038
Repairs, maintenance, and renewals of mains and service pipes.	189,269	3·12	0·57	3·17	0·057
Management	202,239	3·33	0·61	3·38	0·061
Rates and insurance	168,166	2·78	0·52	2·81	0·052
National Health Insurance	13,984	0·23	0·04	0·23	0·004
Parliamentary and law charges	12,048	0·20	0·03	0·20	0·003
Superannuation, sick and accident funds	64,438	1·06	0·20	1·07	0·020
Sundries	6,693	0·11	0·02	0·11	0·002
	£2,313,459	38·16	7·03	38·70	0·703

SOUTH METROPOLITAN GAS COMPANY—PROPOSED PRACTICE.

How three times the heat energy—B.Th.U.—may be sold for the same money.
B.Th.U. required . . . . 23,666,638,050,000 B.Th.U.
Gas to be sold, cubic feet . . 23,666,638,050,000
B.Th.U. per foot.
Tons of coal required . . . 1,183,332 tons, making 20,000,000 B.Th.U. per ton.

Divisor.	Amount.	Per Ton of Coal Gasified. 1,183,332.	Per Therm 100,000 B.Th.U. 236,666,380.	Per 1000 C.Ft. Gas Sold.	Per H.P. of 10,000 B.Th.U. 2,366,663,800.
	£	Shillings.	Pence.	Pence.	Pence.
Manufacture of gas—					
Cost of 1,183,362 tons of coal at 38·70s. per ton at make of 20,000,000 B.Th.U. per ton	2,289,747	38·70	2·32	..	0·232
Less residual products	813,540	13·74	0·82	..	0·082
Total cost of coal, *less* residuals	1,476,207	24·96	1·50	..	0·150
Purifying					
Engineers at works	99,977	1·69	0·10	..	0·010
Wages carbonizing	64,986	1·10	0·06	..	0·006
Repairs and maintenance of works and plant	297,351	5·02	0·30	..	0·030
Total manufacturing costs	1,938,521	32·77	1·96	..	0·196
Distribution of gas—					
Salaries of engineers, including clerks	124,011	2·10	0·12	..	0·012
Repairs and maintenance of mains and service pipes	198,269	3·20	0·19	..	0·019
Management	202,239	3·41	0·21	..	0·021
Rates, insurance, superannuation fund, law and parliamentary charges, &c.	265,329	4·48	0·27	..	0·027
	£2,719,369	45·96	2·75	..	0·275

NUNEATON GAS COMPANY—PRESENT PRACTICE.

Gas sold, 115,372,000 c.ft. B.Th.U. sold, 36,960,000,000. Tons of coal used, 7500—making 4,928,000 B.Th.U. per ton,

Divisor.	Amount.	Per Ton of Coal Gasified. 7,500.	Per Therm 100,000 B.Th.U. 369,603.	Per 1000 C.Ft. of Gas Sold. 115,372.	Per H.P. of 10,000 B.Th.U. 3,696,000.
	£	Shillings.	Pence.	Pence.	Pence.
To manufacture of gas—					
Cost of 7500 tons of coal into store, including cost of cartage and £166 for labour. (33·62 per ton)	12,608	33·62	8·19	26·23	0·819
Less residual products	6,908	18·40	4·48	14·36	0·448
Total cost of coal *less* residuals	5,700	15·22	3·71	11·87	0·371
Purifying—					
Engineers at works	140	0·37	0·09	0·29	0·009
Wages, carbonizing	2,113	5·63	1·37	4·39	0·137
Repairs and maintenance of works, &c. (including £942 for labour).	1,847	4·92	1·19	3·84	0·119
Repairs of retorts (including £42 for labour)					
Total manufacturing cost	9,800	26·14	6·36	20·39	0·636
To distribution of gas—					
Salaries of engineers, inspectors, and clerks	610	1·63	0·40	1·26	0·040
Repairs, maintenance, and renewals of mains £189, and of service pipes £285	474	1·26	0·31	0·99	0·031
To management	1,058	2·82	0·69	2·20	0·069
To local rates and taxes and insurance—					
Local rates	1,271	3·39	0·82	2·64	0·082
To fittings	32	0·08	0·02	0·07	0·002
To National Health Insurance	20	0·05	0·01	0·04	0·001
	£13,265	35·37	8·61	27·59	0·861

NUNEATON GAS COMPANY—PROPOSED PRACTICE.

How three times the heat energy—B.Th.U.—may be sold for the same money.
B.Th.U. required 110,880,000,000
Gas to be sold, cubic foot . . 110,880,000,000
B.Th.U. per foot.
Tons of coal required . . . 5544 tons, making 20,000,000 B.Th.U. per ton.

Divisor.	Amount.	Per Ton of Coal Gasified. 5544.	Per Therm 100,000 B.Th.U. 1,108,800.	Per 1000 C.Ft. of Gas Sold.	Per H.P. of 10,000 B.Th.U. 11,088,000.
	£	Shillings.	Pence.	Pence.	Pence.
To manufacture of gas—					
Cost of 5544 tons of coal at 33·62s. per ton at make of 20,000,000 B.Th.U. per ton	9,320	33·62	2·01	..	0·201
Less residual products	2,000	7·21	0·43	..	0·043
Total cost of coal less residuals	7,320	26·41	1·58	..	0·158
Purifying—					
Engineers at works	140	0·55	0·03	..	0·003
Wages, carbonizing	528	1·90	0·11	..	0 011
Repairs and maintenance of works, &c., including repairs retorts	612	2·20	0·13	..	0·013
Total manufacturing cost	8,600	31·06	1·85	..	0·185
To distribution of gas—					
Salaries of engineers, inspectors, and clerks	610	2·20	0·13	..	0·013
Repairs, maintenance, and renewals of mains £189, and service pipes £285	474	1·70	0·10	..	0 010
To management	1.058	3·81	0·24	..	0·024
To local rates and taxes and insurance—					
Local rates	1,271	4·58	0·28	..	0·028
To fittings	32	0·11	0·01	..	0·001
To National Health Insurance	20	0·07	..	..	..
	£12,065	43·53	2·61	..	0·261

percentage. In both cases the consumer makes use, not of the gas alone, but of a mixture of the gas and air. His measure of quality, therefore, is based on the service he obtains. This service primarily depends on complete combustion at the burner-head allowing the greatest possible flame contact with the object to be heated. When it is considered that, apart from at least equal service, the gas therm with high inerts can be supplied to him for one-third of the cost, or something like it, of any gas with less inerts, the case for gas without any restrictions is overwhelming.

The CHAIRMAN said he had read the statement put in by Mr. Helps

with very great interest; and, speaking for himself, he had found it most informing. It was, indeed, so clear and complete that he would only ask one or two questions on a small number of points of a more or less general character. As he understood it, Mr. Helps's view was, first of all, that as a result of his experiments and investigations there should be no restriction with regard to inerts.

Mr. HELPS said that was so, speaking more particularly in regard to nitrogen.

The CHAIRMAN: And your view is that if inerts are allowed, then cheap gas will result?—Yes.

The CHAIRMAN then asked Mr. Helps's view as regards the limitation of carbon dioxide.

Mr. HELPS said that, of course, it was removable; and the more the calorific value was reduced, the greater the effect of carbon dioxide on the flame, and it never did any good to the gas.

The CHAIRMAN: In other words, the more carbon dioxide there is in the gas, the more detrimental it is for all purposes; and your view is that, apart altogether from the question of nitrogen, the carbon dioxide should be removed by somebody?

Mr. HELPS said he would not go so far as that, because it depended on the percentage and the quality of the gas. For instance, a percentage in a gas of 100 B.Th.U. was much more detrimental than the same percentage in a gas of 500 B.Th.U. He preferred gas without it; but it was an expensive matter to remove it, and if it was removed the consumer would have to pay for the removal in the price of gas.

The CHAIRMAN said he knew that Mr. Helps had done very much in the way of experimenting in these matters, and would like to know if his view with regard to carbon dioxide was founded upon exhaustive experiments.

Mr. HELPS replied that he would not like to say that he had made exhaustive experiments; as a matter of fact, it was not necessary to make exhaustive experiments to ascertain the effect of carbon dioxide, because it was very soon apparent.

The CHAIRMAN: Have you formed any view as to the percentage of carbon dioxide per 100 B.Th.U. which should be allowed in gas?—To be quite candid, I have not considered that; but if I may I should like to consider it and write to the Committee about it.

If you please. The reason I asked was that in your very careful statement you do not mention carbon dioxide except to say that it is removable; and I have in mind that unless there was some compulsion to remove carbon dioxide it is conceivable that the maker of the gas might pass it on to the consumer, who might not be in a position to remove it. But I gather that is a question you would prefer to consider?—Yes.

The CHAIRMAN, in the course of further questions, said he gathered, therefore, that the main point dealt with by Mr. Helps in his evidence was the effect of nitrogen, as such, in the gas. [Mr. Helps agreed.] He also rather gathered from Mr. Helps's statement that a gas of 300 B.Th.U. was the lowest satisfactory limit.

Mr. HELPS said that was not quite so, because he had for a considerable time, with complete success, sent out gas of a lower calorific value than that. Indeed, he thought it was likely that gas would be lower than that.

A diagram was here handed to the Committee, and explained by Mr. Helps, showing the proportions of oxygen, inerts, and combustibles of varying qualities of gas, supporting Mr. Helps's contention that it is possible to send out a gas of 300 B.Th.U. or less through existing mains without any difficulty. A number of other diagrams were also explained in the same connection. In the course of a general explanation of these, Mr. Helps said that whereas in 1914 gas of something over 500 B.Th.U. was being supplied in Nuneaton, in 1920 it was 300, and sometimes a little under; so that in 1920 he was sending out a much greater volume. The pressure at the works was 32-10ths, and 37-10ths respectively, or an increase of only 5-10ths. The result was quite satisfactory. Mr. Helps went on to explain to the Committee, by the aid of diagrams, the greater capacity of 48-in. mains when using the Pleno gas system.

The CHAIRMAN: That is purely theoretical?

Mr. HELPS: No; it is actual, and can be proved by experiment.

The CHAIRMAN: It is a theoretical explanation of a practical conclusion that a 550 B.Th.U. gas is really not so good for the consumer as a 300 B.Th.U. gas?

Mr. HELPS: That is so; and I have gone into the consumers' houses and made tests on the burners being used by the consumers, which prove it.

The CHAIRMAN asked if Mr. Helps would contest the view which he (the Chairman) put in his ignorance, that if a 550 B.Th.U. gas was properly aërated, there would be a corresponding increase in usefulness as in the 300 B.Th.U. gas dealt with in the same way.

Mr. HELPS said he could not concede that, because in the case of a 300 B.Th.U. gas it was a completely combustible mixture. It was not easy to explain why; but it was simple to demonstrate by means of an actual flame. He had made tests which showed that the efficiency in the two cases was not proportionate if time was ignored. Thus, the efficiency obtained with a 150 B.Th.U. gas for boiling water was better with his system than could be obtained with an ordinary 300 or 500 B.Th.U. gas. He would like to have the opportunity of showing the various flames to the Committee, because the result could be so much more easily appreciated.

The CHAIRMAN: I do not know that we have any facilities here for that.

Mr. HELPS then placed before the Committee samples of gas-rings by which he obtains his completely combustible mixture with low-grade gas, and compared them with the ordinary type of gas-ring. He contended that until a completely combustible mixture could be used at the burner, the full efficiency of gas would not be obtained. In answer to the Chairman, he said that by using these types of burner he got substantially complete combustion, although not theoretically complete combustion. Moreover, it was not nearly so easy to regulate in order to get complete combustion, with a high-grade gas as with a low-grade gas. It was the fact that in Nuneaton he had gone down gradually from 500 to 350 B.Th.U. gas without anyone knowing it; and the consumption had not gone up. It was for this very reason that he argued that the difference between the original 500 B.Th.U. gas and the lower value had been wasted, and not put to useful effect. He knew that with the lower-grade gas on his system a completely combustible mixture was being obtained, although he admitted that not quite so good a light was given with a mantle; but with boiling the efficiency was as good with the lower-grade gas as with the higher.

The CHAIRMAN said he could quite understand this point with regard to boiling—namely, that it would take a longer time to give substantially the same result with the lower temperature of the flame; but the question of the mantle seemed a very much more serious matter, as the efficiency of the mantle depended upon the temperature of the flame.

Mr. HELPS replied that much better results could be obtained with lighting with this type of gas if the mantles were made to fit the flame; and the question of efficiency did not depend entirely upon the temperature of the flame. There were many other factors that came into play—such as the condition of the mantle, the adjustment of the nipples, &c. At the same time, lighting was a field for electricity, in his opinion, and not for gas. He did not look upon lighting as of considerable importance, although he did not suggest that lighting should be catered for by the electrical people more than by the gas people. It was possible to produce electricity very cheaply by the use of gas in gas-engines. With regard to the distribution, diagrams were handed to the Committee showing how it is possible to supply gas of 300 B.Th.U. with little, if any, increase in pressure, compared with that necessary for a 500 B.Th.U. gas. When supplying a 500 B.Th.U. gas, a pressure of 32-10ths was adopted, as that was considered necessary to produce effective lighting and heating, whereas with 300 B.Th.U. gas, perfectly satisfactory service was obtained with a pressure of 37-10ths.

Questioned by Mr. BUTTERFIELD on the matter of lighting-back in burners, as the result of using low-quality gas, Mr. Helps stated that lighting-back was mainly due to the flow or velocity of the gas and air mixture passing through the orifices of a burner at a lower speed than the rate at which flame propagation takes place. The smaller the holes in a ring-burner, generally speaking, the less the tendency to light-back. Another cause of lighting-back was the stratification of mixtures of gas and air; the mixtures of gas and air not being intimately associated. The rate of flow of a mixture of gas and air was not necessarily interfered with by reduced pressure, because this could be compensated for by increasing the nipple orifice. The softer the flame—the less aëration—the less the tendency to light-back. If the pressure at the nipple was excessive, the gas issuing therefrom might be over-aërated for the type of burner, and so light-back. It could not fairly be said that a rich gas lit-back more readily than a less rich gas; it was not a question of rich or poor gas, but of rich or poor admixture—the mixture of gas and air in the burner tube, which might or might not be a Pleno mixture.

Mr. BUTTERFIELD said he quite understood that Mr. Helps's argument in favour of gas with high inerts applied to the use of gas in a bunsen burner, and did not apply to certain forms of apparatus which used a luminous flame; and that in these latter cases the suggestion that the whole of the difference between a high-grade and a low-grade gas was wasted, did not apply.

Mr. HELPS agreed, and added that one of his burners could be adapted to burn any grade of gas. He had used on it gas of 80 B.Th.U and up to 700 B.Th.U.

Replying to a question by Mr. BUTTERFIELD as to lighting-back, Mr. Helps said he did not suggest that there would be less lighting-back with less inerts, because the causes of the lighting-back varied considerably, and were chiefly due to bad mixture in the burner.

Mr. BUTTERFIELD: Using your type of burner, you can check lighting-back with gas with high inerts almost completely?—Yes, because there is such a very fine adjustment.

Continuing, Mr. Helps said that if there was any doubt in the minds of the Committee with regard to the statement he had made as to the efficiency of the burners, he would like to be given the opportunity of showing them some of the flames obtained. He could make tests at any time, and he had gone into the matter before the Committee in some detail, because it was so absolutely vital to him.

The CHAIRMAN said that if the Committee desired to see the experiments, they would ask Mr. Helps for them.

Dr. LANDER said he was in a little difficulty with regard to the point made by Mr. Helps about supplying gas at one-third the price. He had an actual figure for the retort-house charges for a certain gas-works of 3d., whereas the gas was being sold at about 1s. per therm. He took it that the shilling covered the retort-house, capital, and distribution, and if it were divided by three, that only gave 4d.——

Mr. HELPS (intervening) said he did not think he had stated that gas could be supplied at about one-third the price. He had been very careful to put it, and he had argued it for many years, that three times the quantity of gas could be supplied for the same money, and he had shown in the diagram submitted to the Committee how, under various conditions, three times the quantity of gas could be produced for the same money, that a less tonnage of coal would be used, and a greater aggregate number of B.Th.U. obtained. He hoped he had made this point clear. For instance, there were cases of large gas companies, such as the Gas Light and Coke Company, or the South Metropolitan Gas Company, in which the bye-products had been sold for a greater sum than the coal originally cost; but if they looked at the figure for repairs and maintenance of the works in these cases, they would see how marked it was. In the case of the South Metropolitan Company, for instance, the total cost of coal, less residuals, was 0·62d. per therm, while the cost of repairs and maintenance of works and plant, less the sum received for old material, was 2·71d. per therm. With a complete gasification plant, the cost of repairs and maintenance would not be anything like so large. There was represented in the figure a sum of nearly £900,000, which the consumer had to pay for the upkeep of plant which allowed the Company to sell bye-products. The figures in the case of the Gas Light and Coke Company were equally significant. The cost of repairs and maintenance in their case amounted to 2¼ millions sterling on plant to allow the Company to sell gas at 5s. per 1000 c.ft. He contended that if they adopted a complete gasification plant they could sell three

times the number of B.Th.U., or even more, for the same money. He did not believe there was any doubt whatever about that; it was an absolutely true statement of what could be done.

Dr. LANDER: The point is quite clear now.

Prof. R. V. WHEELER, of Sheffield University, was then called. He stated that the disadvantage from the consumers' point of view of a high proportion of incombustibles in the gas supplied to an atmospheric burner of the bunsen type lay mainly in the unsteadiness thereby produced in the flame. The maintenance of the steady flame depended essentially upon there being very little variation in the speed of propagation of flame in the mixture issuing at the mouth of the burner—dependent upon inadvertent change in the pressure or composition of the gas affecting the composition of the gas-air mixture. With pure coal gas, and to a more marked extent with mixtures of pure coal gas and pure water gas, considerable variation could occur either in the pressure of the gas or in the relative proportions of the combustible constituents, without there being sufficient variation in the speed of propagation of flame in its mixtures with air, on the upper limit side, to cause any serious alteration in the character of the flame at the bunsen burner. When, however, a considerable proportion of incombustible gas was mixed with combustible gas, a comparatively slight change in the composition of the gas-air mixture, issuing at the burner, caused a marked change in the character of the flame. To take the example given in his paper before the Sheffield Gas Consumers' Association, the extreme amount of variation possible in the percentage of gas in the gas-air mixture issuing at the mouth of the burner—representing the range between (*a*) maximum aëration and (*b*) the upper-limit mixture—was only 2·6 when a coal gas containing 30 p.ct. of nitrogen was used, 3·6 when the percentage of nitrogen was 20, and 4·6 when the percentage of nitrogen was 10. This meant that if a coal gas containing 20 p.ct. of nitrogen was used, there must be frequent adjustment of the burner to guard against the flame either striking-back or going out, to say nothing of the adjustment necessary to maintain the position of the inner cone of the flame, unless the pressure and composition of the gas supply were remarkably constant. He had had occasion to use gas from a town's supply containing just over 20 p.ct. of nitrogen for the continuous heating of muffle-furnaces: and the constancy of either the pressure or the composition, or both, of the gas was not sufficient to enable the furnace to be left without hourly attention. From the experiments he had made, he judged that a straight coal gas, or a mixture of coal gas and coke-oven gas, should contain not much more than 15 p.ct. of incombustibles to ensure reasonable ease of working of bunsen burners supplied with the gas. With mixtures of coal gas and water gas, it might be that a higher percentage of incombustibles—possibly 20 to 25 p.ct.—would not be seriously disadvantageous from the point of view of reliability; but he would not care to make a definite statement on this point without further experiment.

The CHAIRMAN: Do I understand that it is your main or only objection to the increase of incombustibles in gas, that it is difficult to adjust the burner for varying richness or varying pressure, or both?—That is my only serious objection. The other objections are of minor importance.

The CHAIRMAN: The real point is that you have got to be so frequently adjusting your burner for these variations of pressure or richness that it is in your opinion inadvisable to have more than 15 p.ct. of incombustibles in the gas?—That is as far as straight coal gas is concerned, or mixtures of coal gas and coke-oven gas.

The CHAIRMAN: But where you have got coal gas and water gas you suggest 25 p.ct., although you have not made up your mind?

Prof. WHEELER said he had had calculated-out for him theoretically what would be the effect of adding nitrogen to various mixtures of coal gas and water gas; and it was from these figures and curves that he had deduced that for a mixture of 25 p.ct. of water gas and 75 p.ct. of coal gas, as much as 30 p.ct. of nitrogen made no greater difference than did 15 p.ct. of nitrogen added to straight coal gas. Above 15 p.ct. in a straight coal gas made it exceedingly difficult to maintain control over the character of the flame. The tests he had made were carried out with a muffle-furnace, in which there was no question of adjusting nipples; and he had based his conclusions more upon theoretical deductions, for the reason that experiments must take into account so many factors that it would need very considerable experimental work in order to draw definite conclusions from it. It was on this ground that he preferred to base his conclusions on theoretical considerations, which he thought were very strong.

The CHAIRMAN asked whether, if a poor gas properly mixed with air or oxygen and a rich gas properly mixed with air or oxygen were compared, was one more easily combustible than the other on theoretical grounds? He was desirous of finding out whether the real difficulty was mixing the oxygen with the gas.

Prof. WHEELER said that was so; and he agreed with the Chairman that from the theoretical point of view the particular form of burner used was very vital.

Mr. BUTTERFIELD asked if witness had carried out any other experiments than those upon the muffle furnace, either with industrial apparatus or domestic apparatus.

Prof. WHEELER said he had not; but he added that so far as domestic appliances were concerned, in which there were baffles and gauze to obstruct the passage of the gas, he did not think this should make any material difference in maintaining the flame at the burner mouth, as compared with an open tube, such as he had used in his experiments with the muffle furnace. Neither did he think that domestic appliances would affect the question of striking-back as compared with an open tube. Striking-back was due to the speed of propagation of the flame in the mixture issuing at the mouth of the burner becoming greater than the speed of the flow; and he did not see how the apparatus could affect this. It might, however, if the interstices were small enough.

Mr. BUTTERFIELD pointed out that it was very general with burners for gas-fires to have lighting-back devices—for instance, the Méker and the Kern burner.

Prof. WHEELER said that the feature of the Méker burner was that a more fully aërated mixture could be used.

Mr. BUTTERFIELD: But having maintained your flame at the burner head, you would still be at a disadvantage with gas with a higher percentage of inerts?—I think so, because there is such a very rapid change in the speed of propagation of the flame, depending on the comparatively small change in the composition.

The CHAIRMAN: We have your recent article in the "GAS JOURNAL," which we will read in conjunction with your evidence.

Prof. WHEELER said he could add to that curves showing the effect of adding nitrogen to pure coal gas, and to a mixture of 25 p.ct. of water gas and 75 p.ct. of coal gas, and 50 p.ct. of water gas and 50 p.ct. of coal gas. From these, it was easily apparent how the addition of water gas widened the curvature of the graph. As much as 30 p.ct. could be added without getting the troublesome sharp drop in the slope of the curve.

In reply to the CHAIRMAN, Prof. Wheeler said he did not feel competent to express any opinion on the question of the advantages of adding nitrogen; and he had made no observations with regard to the presence of carbon dioxide, which to all intents and purposes acted as intensified nitrogen. He did not wish to put forward any views whatever as to this.

GAS REGULATION ACT APPLICATIONS.

The following further notices have appeared in the "London Gazette" of applications by gas undertakings to the Board of Trade for Orders under the Gas Regulation Act.

British Gas Light Company, Ltd. (Trowbridge Station).

The maximum price now authorized in respect of the supply of gas by the undertakers is 4s. 6d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 7d. per therm.

Cannock, Hednesford, and District Gas Company, Ltd.

The standard price now authorized in respect of the supply of gas by the undertakers is 3s. 3d. per 1000 c.ft.; but under the sliding-scale applicable to them the authorized rate of dividend on their ordinary capital is not reduced below the standard rate unless the price per 1000 c.ft. exceeds 3s. 6d. The prices which the undertakers have asked the Board of Trade to substitute for these are respectively 1s. 5·1d. and 1s. 5·7d. per therm.

Chesham and District Gas Company.

The standard price now authorized in respect of the supply of gas by the undertakers is 3s. 9d. per 1000 c.ft. within a radius of three miles from the Town Hall at Chesham (the "inner area"); and for gas supplied elsewhere within the limits of supply (the "outer area") a price not exceeding the price charged in the inner area by more than 1s. per 1000 c.ft. But the undertakers may at any time charge in any part or parts of the outer area a price or prices lower than the price or prices charged in any other part or parts of the outer area, provided that such lower price or prices shall not be less than the price for the time being charged within the inner area. The standard price which the undertakers have asked the Board of Trade to substitute for this is 1s. 7d. per therm for gas supplied within the inner area; and for gas supplied within the outer area a price not exceeding the price charged in the inner area by more than 2·5d. per therm. But the undertakers may at any time charge in any part or parts of the outer area a price or prices lower than the price or prices charged in any other part or parts of the outer area provided that such lower price or prices shall not be less than the price for the time being charged within the inner area.

Cirencester Gas Company, Ltd.

The standard price now authorized in respect of the supply of gas by the undertakers is 4s. 3d. per 1000 c.ft; and the price they have asked the Board of Trade to substitute for this is 1s. 9d. per therm.

Farnham Gas and Electricity Company.

The standard price now authorized in respect of the supply of gas by the undertakers is 3s. 6d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 17·65d. per therm.

Leighton Buzzard Gas Company.

The standard price now authorized in respect of the supply of gas by the undertakers is 2s. 10d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 16·29d. per therm.

Lymington Gas and Coke Company, Ltd.

The maximum price now authorized in respect of the supply of gas by the undertakers is 5s. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 9d. per therm.

Merthyr Tydfil Gas Company.

The standard price now authorized in respect of the supply of gas by the undertakers s 2s. 9d. per 1000 c.ft.; and the price they have asked the Board of Trade to substitute for this is 1s. 4·5d. per therm.

Romford Gas and Coke Company, Ltd.

The standard prices now authorized in respect of the supply of gas by the undertakers are 4s. 6d. per 1000 c.ft. for gas supplied within a circle having for its centre the middle point of the main entrance to the works of the undertakers as existing at the passing of the Act confirming the Romford Gas Order, 1874, and a radius of one mile; and 4s. 9d. per 1000 c.ft. for gas supplied beyond that circle. The prices which the undertakers have asked the Board of Trade to substitute for these are respectively 1s. 6·8d. and 1s. 7·4d. per therm.

DECLARATIONS OF CALORIFIC POWER.

Portsea Island Gas Light Company.—450 B.Th.U. (June 1.)
Warwick Gas Company.—470 B.Th.U. (June 22.)

SPECIAL ORDERS.

Cambridge University and Town Gas Light Company.

Application is made by the Company to the Board of Trade under section 10 of the Act for a Special Order to enable them to raise addi-

tional capital; to grant pensions and superannuation allowances; to make provision with reference to the price of gas in different circumstances; to make special provision with reference to cases where the consumption of gas to any premises is, or will be, increased beyond the capacity of the meter, and where high-pressure air is intended to be used in connection with the consumption of gas; to authorize the Company to utilize certain pipes for the conveyance of tar and other materials; and for other purposes.

Borough of Chelmsford.

Notice is given by the Town Council of an application for an Order to authorize them to borrow at interest a sum not exceeding £5000 for the purchase of certain land, hereditaments, and premises situated in Wharf Road, in the borough of Chelmsford, and commonly known as the Albert Iron-Works.

Romford Gas and Coke Company, Ltd.

The Company are applying for a Special Order to enable them to increase the share capital; to prescribe a new standard rate of dividend; to authorize them to provide out of revenue, and as part of their expenses on revenue account, a fund for the redemption of any redeemable preference shares or stock or redeemable debenture stock which may be issued by them; to authorize them to establish a renewal fund out of revenue; to empower them to use certain lands for manufacturing and other purposes; to enable them to buy or sell gas in bulk; and to make regulations for the supply of gas.

Southgate and District Gas Company.

The Company are applying for an Order to increase their borrowing powers; to authorize profit-sharing schemes; to make new provisions as to meetings, &c.; and to make regulations with regard to the supply of gas.

Welwyn, Knebworth, and District Gas Company, Ltd.

Application is being made by the Company for an Order to enable them to raise additional capital; to acquire further lands; to purchase gas in bulk from bodies or persons authorized to supply gas beyond their limits of supply; and to make provisions with reference to various matters affecting the supply of gas.

GAS REGULATION ACT ORDERS.

SECTION 1.

Gorleston and Southtown Gas Company.

As from the declared date, the maximum price in respect of gas supplied by the undertakers shall be 21·6d. per therm. (June 3.)

Portsea Island Gas Light Company.

After the declared date, the standard prices in respect of gas supplied by the undertakers shall be 16d. and 18·8d. per therm; and these prices respectively shall be substituted for the prices of 3s. 4d. and 4s. 6d. per 1000 c.ft. mentioned in section 31 (fixing maximum price of gas with sliding-scale as to dividend) of the Portsea Gas Order, 1882.

For the purpose of ascertaining the authorized rate of dividend for the year in which the declared date occurs, the price charged per 1000 c.ft. during that part of the year (if any) before the declared date shall be rendered into the equivalent price per therm by dividing it by four-and-one-half. (May 30.)

SECTION 10.

Ossett Corporation.

Under a Special Order made by the Board of Trade, the Corporation may enter into and carry into effect contracts and agreements with any company, body, or person producing gas in connection with the carrying-on by such company, body, or person of any works, trade, or business, whether within or outside the limits of supply, with reference to the purchase and taking by the Corporation of a supply of gas from that company, body, or person; and for the purposes of any such agreement the Corporation may, within the limits of supply and (with the consent of the road authority for any road which may be affected) outside those limits exercise the powers, with respect to the breaking-up and reinstatement of streets and the laying of mains, pipes, valves, syphons, and other works, conferred upon them by the Acts of 1900 and 1914 or either of them, and may utilize any gas so purchased in carrying on their gas undertaking.

All expenses incurred by the Corporation under this section may be paid, as regards expenses to which capital is properly applicable, out of moneys to be borrowed by the Corporation for the purposes of their gas undertaking with the approval of the Minister of Health under the Acts of 1900 and 1914, and as regards any other such expenses out of the revenue of the undertaking.

There are sections for the protection of the Great Northern and the Lancashire and Yorkshire Railway Companies.

Dearer Gas at Stockton.—The Stockton-on-Tees Corporation last Thursday decided to increase the price of gas from 4s. per 1000 c.ft., with 10 p.ct. discount as follows: Stockton, 4s. 11d.; Thornaby, 4s. 11d.; Eaglescliffe, 5s. 9d.; Billingham, 5s. 9d.; Wolviston, 6s. If the amounts due under this scale are not paid within fourteen days, an additional 10 p.ct. will be charged. The scale to power consumers will be: Stockton, 4s. 5d. per 1000 c.ft. for the first 50,000 c.ft.; Thornaby, 4s. 5d.; Eaglescliffe, Billingham, and Wolviston, 4s. 11d.

Demands of Sidmouth Gas-Engines.—The Chairman of the Sidmouth Urban District Council (Mr. J. G. H. Halse) said users of gas had complained that, when the gas was turned-on, they had one part gas and nine parts air. This was no fault of the undertaking, but was due to the fact that owners of gas-engines, during the restricted period, took all the gas out of the mains. The result was that other people in the districts suffered. The Committee had notified owners of engines that, were this practice continued, the supply would be cut off altogether. Gas was costing something like 10s. per 1000 c.ft.; and the Council were losing 2s. 6d. per 1000 c.ft.

NOTTINGHAM GAS PROFITS.

A Yield of £96,575.

In the present decadent commercial condition of the city, with heavily increased rates now totalling 16s. 8d. in the pound, Nottingham residents find the only partial alleviation of municipal burdens again afforded this year by drawing upon the profits of the gas undertaking to the extent of £30,000. The point, however, is being again seriously raised locally as to how far the practice is to be perpetuated of involving gas consumers, who are also ratepayers, in a double obligation, from which non-consumers escape.

The Gas Committee recorded in a report (to which the tenth of his annual series was added by the Engineer and General Manager, Mr. John Wilkinson) that the income for the past year, upon the revenue account, had amounted to £773,980, and the expenditure to £667,404—leaving a balance of £96,575 to be carried to the profit and loss account. To this was added £6037, representing interest on general account investments, together with £32,216 brought forward from last year. After charging interest on capital, the annual contribution to the sinking funds, £3500 for depreciation of stoves, and £5000 for depreciation of meters, an available balance was left of £66,697. The Council having decided to take £30,000 of such balance as a contribution in aid of the general district rate, it was recommended that, in view of the continued heavy calls for maintenance work, the balance of £36,697 be carried forward.

The quantity of gas sold during the year was 2,273,970,400 c.ft., against 2,263,951,400 c.ft. the previous year. The amount of gas sold per ton of coal carbonized was 13,463 c.ft., as against 13,251 c.ft. in the preceding year. No change in the scale of charges for gas supplied took place during the year. The Committee were pleased to report that it had been possible during the year to obtain reasonable deliveries of plant and materials to carry out the necessary repair and maintenance work, and that good progress had been made in such work, but unfortunately at great cost, seeing that abnormally high prices for materials and labour continued throughout the year. The effect of these high prices was very clearly demonstrated by comparing the figures for gas sold and total expenditure for the past year with the corresponding figures for the year ended March 31, 1914, as follows:

Year ended	Gas Sold (Cubic Feet).		Total Expenditure.
March 31, 1921	2,273,970,400	..	£677,405
March 31, 1914	2,251,302,700	..	250,995
Increase . . .	22,667,700	..	£426,410

In other words, the expenditure per million cubic feet of gas sold had increased from £111 9s. 9d. for 1914 to £297 18s. for the year ended March last—or (say) 167 p.ct.

MR. JOHN WILKINSON'S REPORT.

In amplification of the Committee's general statement, many details are embodied in the report of the Engineer and General Manager, who explains that during the period under review 165,733 tons of coal and 66,268 gallons of oil were utilized in course of manufacturing the following products: 2,287,331,000 c.ft. of coal gas and 43,715,000 c.ft. of water gas—total, 2,331,046,000 c.ft. The continuous tar distillation plant at Basford was put into operation in November last; and the quantity of tar manipulated at Giltbrook and Basford during the year was 1,706,520 gallons. The Giltbrook works were also used for the manufacture of 2126 tons of sulphuric acid (100 p.ct.) and 770 tons of oxide of iron for purification purposes. At the Basford ammonia works the equivalent of 23,098 tons of 10-oz. ammoniacal liquor was distilled during the year, which produced 1999 tons of sulphate of ammonia. The transfer of their tar distilling operations from Giltbrook to Basford has now been completed; and considerable saving in transport charges will therefore be effected.

The following are the details of the sale of gas during the year: Ordinary consumers, 1,189,540,900 c.ft.; prepayment consumers, 734,327,800 c.ft.; power consumers, 270,212,800 c.ft.; gassing consumers, 15,543,800 c.ft.; and public lamps, 64,345,100 c.ft.—total, 2,273,970,400 c.ft. These figures indicate an increase of 10,019,009 c.ft., or 0·44 p.ct., when compared with the sale of gas (2,263,951,400 c.ft.) for the previous year. The following are the comparative receipts for gas sold: Year ended March 31, 1921, £521,004; 1920, £444,765; increase, £76,239. The gas unaccounted for during the year was 2·45 p.ct., as compared with 5·70 p.ct. for the previous year. The sale of gas per ton of coal carbonized was 13,463 c.ft., as compared with 13,251 c.ft. for the previous year. The average consumption per meter (exclusive of lamp meters) equalled 25,304 c.ft., as compared with 25,996 c.ft. in the previous year. The condition of the dry meters fixed in the various districts comprised in the area of supply is receiving close attention; but the position is one which will always require very careful supervision. Mr. Wilkinson also points out that the position of gas in regard to its application for trade and domestic purposes, other than lighting, has been maintained; and on March 31 there were in use in Nottingham and the district: Gas cooking-stoves, 37,392; gas-fires, 21,044; and gas-engines, 917—these being approximate figures.

The following are the comparative expenditure for coal and income from residuals during the last three years:

	Expenditure for Coal.		Net Income from Residuals.
Year ended March 31, 1921. .	£310,748	..	£224,651
,, ,, ,, 1920. .	214,648	..	165,393
,, ,, ,, 1919. .	158,882	..	117,403

The actual result of the revenue account for the year is represented as follows: Total income, £773,980; total expenditure, £677,405; gross profit, £96,575. Mr. Wilkinson concludes his report by observing: "The markets and general conditions controlling the gas industry still remain very unstable; and costs for materials, wages, &c., have continued to increase during the year. On the other hand, there was a remarkable slump in the prices obtainable for coke and tar and ammonia products towards the end of the year; the export markets for pitch and sulphate of ammonia being practically closed."

BRIGHTON AND HOVE GENERAL GAS COMPANY.

A Formal Meeting.

A Special General Meeting of the Company was held at the Offices, No. 5, Great Winchester Street, E.C., last Friday, for rectifying certain words erroneously written in a resolution passed on June 17, 1920, and adopting and confirming certain actions of the Directors in respect thereof; also empowering the Directors (1) to take no further action under certain resolutions passed at meetings on May 9, 1919, June 17, 1920, and Aug. 27, 1920, as to raising further additional capital, and (2) to raise additional capital and to exercise the borrowing powers authorized by the Brighton and Hove Gas Acts, 1839 to 1920, and the Acts and Orders incorporated therewith.

The SECRETARY (Mr. E. L. Burton) read the resolutions, which were to the following effect:

1.—That a resolution of the Company passed on June 1, 1920, be read and construed as if the words "not exceeding ten years" had been written (as they were intended to be written) "not exceeding fifteen years," and that the action of the Directors in issuing stock redeemable within fifteen years instead of ten years be adopted and confirmed.

2.—That no further action be taken on resolutions passed at the general meetings of the Company held on May 9, 1919, June 17, 1920, and Aug. 27, 1920, respectively, as to raising further additional capital under the powers of the Brighton and Hove Gas Acts, 1839 to 1920, the Statutory Companies (Redeemable Stock) Act, 1915, as extended and amended by the Public Utility Companies (Capital Issues) Act, 1920, and other matters therein referred to.

3.—That under the powers of the Brighton and Hove Gas Acts, 1839 to 1920, and Acts incorporated therewith, and of the Statutory Companies (Redeemable Stock) Act, 1915, the Public Utility Companies (Capital Issues) Act, 1920, and the Brighton and Hove General Gas Company (Capital Issues) Consent, 1921, or any one or more of them, and subject to any further consents that may be required from time to time, the Directors be authorized to raise the additional capital and exercise the borrowing powers set out in the resolution.

4.—That any issues of redeemable or irredeemable preference stocks or shares authorized at this meeting shall be entitled to such rates of dividend as the Directors may determine at the time of each issue; and the holders of such redeemable or irredeemable preference stocks or shares shall be entitled to the like rights of voting in proportion to the amount of their stock or shares from time to time paid up as the holders of stock or shares in the ordinary capital.

5.—That the Directors are authorized from time to time: (1) To fix the date for redemption of each class or issue of redeemable preference stocks and shares or redeemable debenture stocks authorized to be created and raised. (2) To exercise from time to time, or at any time as deemed desirable, any of the powers conferred upon the Company by section 17, sub-section 2, of the Brighton and Hove Gas Act, 1920.

Thes resolutions were passed, on the proposition of the CHAIRMAN Mr. A. M. Paddon), seconded by the DEPUTY-CHAIRMAN (Mr. G. W. Carey).

STOKE-ON-TRENT CORPORATION GAS SCHEME.

Negotiations for the Purchase of the British Gaslight Company's Potteries Works.

The Stoke-on-Trent Town Council, at a special meeting on Thursday last, decided on the purchase of the Potteries undertaking of the British Gaslight Company, at a price which will amount, in round figures, to £400,000. A further sum of £470,000 may have to be spent on erecting additional plant and in extensions; and altogether the new capital of the Corporation on its gas undertakings will amount to over £1,000,000. The report of the Chief Gas Engineer (Mr. A. Mackay) stated that, with the purchase price of £345,000, the liability for £40,000 mortgage debentures, and the addition of £15,000 for the costs of transfer and compensation to officials, he took the total sum required for purchase as about £400,000.

Mr. Mackay, in a report to the Gas Committee, submitted his views on the working of the British Gaslight Company's undertaking itself, and also on the concentration of the manufacture of gas at Etruria, which would involve the closing of the four works at Burslem, Stoke, Fenton, and Longton, belonging to the Corporation. In recommending the purchase of the Company's works, which he thought would be quite a sound commercial proposition, Mr. Mackay said it was not in his mind that the works should be carried on as at present, but that the concentration of the manufacture of gas for the whole of the Potteries area should be carried out on the site at present occupied by the Company's works. He advocated this policy of concentration in preference to an estimated expenditure, during the next ten years of £285,500 on the Corporation's existing undertakings. With a central works, the existing Corporation works would no longer be required, excepting the gasholders for the purposes of storage and distribution and by the erection of plant at the central works, the make of gas per ton of coal would be increased by one-third, and would result in an annual saving of over 30,000 tons of coal. Increased profits might also be expected from residuals and bye-products; and the amount received by the erection of their own tar distillation plant and sulphate plant would go a very long way towards paying the cost of the coal carbonized. The new capital of the Corporation undertaking that would be created would, therefore, be approximately as follows: Outstanding balance of capital on which interest and redemption fund

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is paid, £200,937; purchase price of the British Gaslight Company's undertaking, £400,000; approximate cost of erection of additional plant, £470,000; total, £1,070,957.

Alderman A. BROOKHOUSE (the Chairman of the Committee) moved the following recommendation of the Gas Committee: "That, in the event of the negotiations between the British Gaslight Company and the Corporation being carried to a successful issue, and the Company being willing to accept the sum of £345,000 for their Potteries undertaking, to be paid as to £100,000 in cash and as to the remainder in Corporation bonds, the Corporation also taking over liability for a £40,000 3½ p.ct. debentures, the Council do approve of the purchase, and that the Town Clerk be instructed to take the necessary steps to obtain parliamentary sanction to the transfer." He gave a brief outline of the history of the negotiations with the Company, and paid a tribute to the courtesy of the Chairman (Mr. Henry Woodall) and Secretary (Mr. A. W. Brookes). He was authorized by the Engineer to say that he was satisfied with the lay-out of the works, which stood on 25 acres—thus allowing plenty of room for future extensions. While the Engineer did not believe that there was opportunity of increasing the production of gas at the Company's works by 100 p.ct., he was of the opinion that the producing capacity of the manufacturing plant was being increased to an amount which would supply Fenton and Stoke. Regarding the purchase price, he said really the first offer of the Company was £360,000, with the acceptance of the £40,000 mortgage debentures at 3½ p.ct.; but eventually the deputation from the Corporation got them to amend their offer to £345,000, *plus* the debentures, which made a total of £385,000. In his opinion, the offer was far below the cost at which the works could be put up, not only to-day, but even before the war. The total capital ranking for annual charge on the Corporation gas undertakings would be reduced in future. In March, 1921, the total capital ranking for annual charge was £438,959, with over £20,000 annual charge thereon. By 1929, however, loans would have dropped out to the amount of £190,000, and the annual charge would have been reduced by £9111. By 1939, there would have dropped out £340,300 of that total, leaving only £98,659 liabilities on the four undertakings; and the annual charge would have been reduced by £15,823, leaving only £4440 on the whole of the liabilities of the present undertakings. This was an important matter to take into account, when considering the question of the expenditure of further capital. On the Longton works, by 1928, £110,000 of loans would have dropped out; and the annual charge on those works would be reduced by £5570. On the Stoke works, by 1934, £64,300 would have dropped out of their liabilities, reducing the annual payment by £3034. At Fenton, there was a short loan, which dropped out in 1928, reducing the annual payment by £295; but by 1935, £48,000 would have dropped out. At Burslem, by 1937, there would be a reduction of £4834 on the annual charge. It was important for the Council to bear in mind that in eight years almost half of the capital charges would have disappeared. The Company were committed to an expenditure of £64,000 at the present time for plant for increasing production. The only alternative to purchasing the Company's undertaking was to continue in the more than unsatisfactory present way. The existing method was one whereby, no matter how much money they spent, they could not hope to get the best results, and one which no business man would tolerate. If they continued on the old lines, the Engineer estimated that £285,000 would have to be spent on the undertakings during the next ten years; and this would effect practically no economies.

Alderman T. MITCHELL, in seconding, remarked that the scheme was one for centralization, which, in his opinion, would reduce the price of gas.

Alderman J. S. GODDARD (the Chairman of the Finance Committee) moved the following amendment: "That the price asked by the British Gaslight Company for the purchase of the Potteries station by the Corporation is much too high, and that further negotiations be entered into, with a view to a much more satisfactory price being arranged." In doing so, he said he hoped to be able to justify his opposition by quoting facts and figures which would convince them that what he was proposing was reasonable and just. The capital of the Etruria station, as put down in the Company's own balance-sheet for the last year of accounts, was £245,557; and the capital for the same works in 1910 was £231,000 (in round figures). He had taken the profit and loss account for the last eleven years, and found that the profit had varied from £18,000 (the highest) down to £7200, the return for the last year; the average profits obtained for the past eleven years being £12,626. This average profit over the eleven years, on the average capital for the same period, gave a return of only 5¼ p.ct., which was quite a small return. He was satisfied that a figure very much below the one mentioned would do full justice to the shareholders. The total capital of the Company in their balance-sheet of 1920 was £1,406,477, made up of £570,000 ordinary shares, £85,000 7 p.ct. preference cumulative shares, £426,500 mortgage debentures, and £324,977 premiums realized on shares and debentures, making a total of £1,406,477. The capital expenditure on the various works amounted to £1,343,000, which, added to the amount of working capital, totalling £140,451, made a total of £1,483,510. He contended that if a figure were paid by the Corporation for the purchase of the works which would give back to the shareholders of the Company their full £1 per £1 share, they would be in a position to invest their money at a better rate of interest than they were getting at the present time. He was not prepared to state a definite figure at the moment; but, on the basis of £1 per £1 share, *plus* the amount spent on new works, and possibly something for arrears of interest, a lower purchase price could be arranged which would be a fair figure for the Company and for the Corporation.

Mr. F. COLLIS seconded the amendment, and said he believed purchase of the Company's undertaking was the best policy for the Corporation to adopt; but he wanted to be satisfied that the Corporation were making a good business deal.

The TOWN CLERK (Mr. E. B. Sharpley), replying to Mr. F. T.

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Harvey, said that up to last week the Company were restricted in the amount they might charge for gas. Last week, however, they obtained an Order from the Board of Trade, giving them the necessary power to charge up to 5s. 6d. per 1000 c.ft. for their gas. This would enable them not only to pay the full dividend on their shares, but also to make up the arrears.

After further discussion, the Town Clerk, in reply to Mr. J. A. Dale, expressed the opinion that, if the Corporation decided to take steps to acquire the undertaking compulsorily, the Parliamentary Committee would not agree to the fixing of a price equal only to the capital value of the undertaking. One reason for this was the fact that the Company had now obtained an Order from the Board of Trade authorizing them to make higher charges than they had been able to make in the past. The amendment was then put, and lost by 43 votes to 17. The motion, approving the purchase at the price stated, was then carried, with five dissentients.

LEEK GAS-WORKS ACCOUNTS.

A paragraph appeared in last week's "Journal" in which it was stated that the gross profit on the past year's working on the Leek Urban District Council gas undertaking amounted to £2500. Mr. R. H. Ginman (the Engineer and Manager), who, as was then remarked, was the recipient of highly appreciative remarks on the part of the Committee, has written to point out that the gross profit was actually £4947, and the net profit £2491.

From Mr. Ginman's seventh annual report and analysis of accounts, it is seen that the quantity of gas sold through ordinary meters in the twelve months ended March 31 amounted to 79,236,500 c.ft.; the ordinary rental being increased by £2338. The gas consumed by slot-meters totalled 42,896,400 c.ft.; the money collected from these meters showing an increase of £2198. The total income came to £40,472, against £33,338 for the preceding twelve months. The expenditure was £35,526, against £31,364—the increase being due to higher cost of coal, materials, and wages. There was a net profit of £2491, against a net loss of £336 a year ago.

The coal carbonized last year amounted to 9100 tons; the gas made being 139,000,000 c.ft., against 140,749,000 c.ft. in the previous year. There was an increased make of gas per ton representing a clear net saving on the year of £1082. Mr. Ginman adds that the working results and the financial ones are the highest and best records ever produced by the gas-works. Considering they were obtained from an inclined retort plant now 21 years old, the results are, he adds, very creditable, and certainly not exceeded by any other works with similar plant. He considers the financial position of the gas undertaking absolutely sound.

TROUT AND TARRED ROADS.

It is, says "The Times," expected that useful information as to the actual effect of road drainage on trout fisheries will result from the work of the Joint Committee of the Ministry of Transport and Ministry of Agriculture and Fisheries who are considering this question. It is admitted that, in the very early days of road-tarring, when road authorities had not very much knowledge of the material they were using, there were many cases of fish poisoning through the drainage of tarred roads. There is to-day, however, a strong body of opinion which holds that, if tar is used in accordance with the specification adopted in the days of the Roads Board, no great harm can arise, though it is conceded that, where a stream is already suffering a considerable amount of pollution from other sources, a very slight addition from the roads may have a disastrous effect.

The problem is one of importance, and any light which the Joint Committee may be able to throw on it will be of value. Some county authorities are at present incurring considerable expense to provide that the road drainage is carried to one feeder, where it is filtered before it passes into the stream, and in other cases money is expended upon diversion to avoid the pollution of small areas, such as watercress beds. It has been generally assumed that bitumen, in addition to its other qualities of being less susceptible to heat or cold, and not getting tacky like tar, is harmless to fish and other animal life. All other things being equal, the bitumen age might be approaching. But the price is a great consideration to roadmakers in these days; and an addition of 1d. per yard to the cost of a road means £60 per mile. County surveyors who are faced with the double problem of constructing roads as cheaply as possible and avoiding river pollution, are expecting that, as a result of the inquiry now in progress, they will obtain data as to the relative injurious effects of bitumen and tar upon the fisheries which they have to consider, which will be of considerable assistance in drawing-up economical road schemes.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

London, *June 6.*

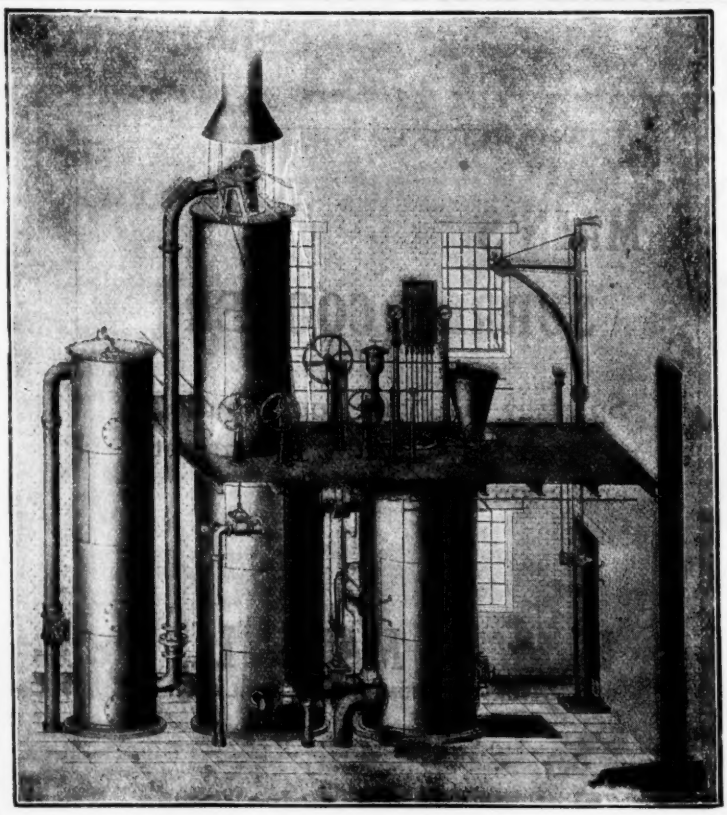
The London market for tar products has not yet improved; and apart from road tar and some home sales for pitch, there is little of interest to report—prices remaining nominal at former quotations.

Sulphate of ammonia for June delivery on a basis of 24¾ p.ct. ammonia is £18 10s. per ton for agricultural purposes.

Tar Products in the Provinces.

June 6.

The average values for gas-works products during the week were:



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Gas-works coal tar, 53s. 6d. to 57s. 6d. Pitch, West Coast—Manchester, 65s. to 67s. 6d.; Liverpool, 65s. to 67s. 6d.; Clyde, 65s. to 67s. 6d. Benzole 90 p.ct. North, 2s. 4d. to 2s. 6d.; crude 65 p.ct. at 120° C., 1s. 11d. to 2s., naked at makers' works; 50-90 p.ct., naked, North, 2s. 11d. to 3s. 1d. Toluol, naked, North, 3s. to 3s. 1½d. nominal. Coal tar crude naphtha in bulk, North, 11½d. to 1s. Solvent naphtha, naked, North, 2s. 3d. to 2s. 4d. Heavy naphtha, North, 2s. 9d. to 3s. Creosote, in bulk, North, liquid, 8½d. to 9d.; salty, 8d. to 8¾d. Heavy oils, in bulk, North, 10½d. to 11½d. Carbolic acid, 60 p.ct., 1s. 6d. to 1s. 9d. Naphthalene, £20 to £30; salts, £7 to £9, bags included. Anthracene, "A" quality, 10d. to 1s. per minimum 40 p.ct.; "B" quality, nominal.

FROM A MARKET CORRESPONDENT.

Tar Products.

The continuation of the coal strike has prevented any development in these products since my last report. Pitch remains about the same, and opinion inclines more than ever to the view recently expressed that the bottom has been touched. Latest values are in the neighbourhood of 65s. per ton. The reduction in the price of petrol has brought about a reduction in benzole prices—90 p.ct. being nominally quoted at 2s. 6d. per gallon. It is rather interesting to note, however, that there is no British benzole on the market at the moment. Pure benzole is quoted at 3s. There are more sellers than buyers of creosote at the moment; and it says a lot for the stability of the market generally that prices are maintained in the neighbourhood of 8½d. per gallon. Solvent naphtha is scarce and quoted 2s. 6d. per gallon; but heavy naphtha is about 2d. per gallon cheaper. There has been much weakness in cresylic acid, and the price of pale, 97-99 p.ct. is now down to 2s., with dark 95 to 97 p.ct. at 1s. 10d. per gallon. The naphthalenes are inactive; refined being £18, and crude £7 10s. to £10 per ton. In intermediate products, beyond the fact that still more of both consumers' and producers' works have been shut down owing to the lack of coal, there is nothing fresh to report. Salicylic acid continues in request at last quoted rates; while the inquiry for aniline oil and salt is rather better, although so far as can be gathered the prices are unchanged.

Sulphate of Ammonia.

The position here is uncertain while awaiting the decision with regard to prices for next season. One factor which will doubtless carry weight in fixing these new prices is lack of production due to the continued coal strike, which, having dragged on for nearly eleven weeks, shows little signs of settlement beyond the general feeling that it cannot go on much longer. The most hopeful feature of this trade is the increasing amounts being exported. Doubtless, however, the lower prices which have been established recently have served to stimulate this demand, especially from France and Spain, including the Canaries. On the other hand, no exports have been made to Japan, which country used to be one of our best customers in this material, but is now apparently manufacturing sufficient to supply her own needs. Although things are quiet here, there appears to have been more activity for domestic consumption in the United States. The demand for export, however, seems practically dead; and it is some time since any business of consequence has been carried through there for material to be shipped abroad.

Breakdown at Ottery St. Mary.—Owing to a breakdown of machinery at the Ottery St. Mary Gas-Works, the supply for the town is discontinued; and great disconcert is being caused to those inhabitants who are without a coal-range.

American Coal and Vertical Retorts.—It has been reported to the Dundee Gas Committee by the Engineer and Manager (Mr. Alexander Yuill) that, immediately on the arrival of a cargo of American coal, some of the vertical retorts were charged with it; but great difficulties were experienced owing to its high coking tendency. After being subjected to heat, it appears to swell, and practically becomes solid. They are experimenting at the works by mixing breeze with the coal, to see if this will keep it more open. In the horizontal retorts, the coal does all right; and Mr. Yuill has arranged to relight 72 of these retorts.

Curtailment Cancelled at Leeds.—Last Friday the Leeds Gas Committee cancelled the drastic curtailments of gas supply decided upon on Wednesday, and intended to operate as from June 4. Leeds has been well situated for fuel supplies; and the announcement of restrictions came as a surprise to the public, though they had been warned that something of the sort would occur if they did not exercise more economy voluntarily. Between Wednesday and Friday, the Chairman and Vice-Chairman of the Committee (Aldermen W. Penrose-Green and George Ratcliffe) and Mr. C. S. Shapley (the Gas Engineer) hunted high and low for more coal, and succeeded to such an extent that Friday's cancellation included an assurance that the full supply can still be maintained.

Removal of Gas-Works Coal.—Mr. J. S. Ineson, the Managing-Director of the Ventnor Gas and Water Company, recently addressed to the local Council a letter complaining that nearly 100 tons of coal which the Company had in store at the railway station had been seized, put into trucks, and sent out of the town. This was done without any intimation to the Company that the coal was to be taken from them. This forced the Company to issue a notice severely restricting the supply of gas. The Clerk to the Council informed Mr. Ineson that the instructions to remove the coal were given from the Coal Controller's office at Portsmouth. Later it was stated that Mr. Ineson had been successful in obtaining a small quantity of coal from a cargo expected to reach the Island. This will enable the gas supply to be improved, though not quite to normal conditions.

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DEAR SIRS, *1st April*, 1921.

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I might first mention that we were unable to carry out your suggestion to apply the "Everok" by means of a spraying machine as such was not available and consequently had no alternative but to apply the "Everok" with an ordinary hand brush.

Even with this superficial application I am pleased to inform you that the brickwork shows absolutely no deterioration whatever after nine months' continuous use, although in the ordinary course of events (due to our unfortunate method of working) we should have anticipated signs of deterioration within two months. The preservation of the brickwork is so remarkable that I estimate we have already saved the cost of material and labour many times over apart from the question of economy in fuel. Even the workmen remark how nice and cool it is in front of the bench treated with "Everok."

Whilst I shall be delighted to allow any Engineer to inspect the Retort Bench in question and obtain any information he may require, I think the cost of labour and materials necessary to coat an ordinary retort bench so small compared with the remarkable results obtained that I have no hesitation in recommending every Gas Engineer to make the experiment for himself.

Yours faithfully,
Name on application.

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Gas Oil Cheaper in New York.

An announcement has been made by the Consolidated Gas Company of New York to the effect that they expect to be able, as from the beginning of August, to procure gas oil at a price of 6 c. per gallon, as compared with the present contract price of 12¼ c. per gallon. By this favourable change, the Company are arranging that the consumers shall promptly benefit. As a matter of fact, when the price of gas was last February put up to $1.50 per 1000 c.ft., it was intimated that the charge would be reduced as soon as decreases in the cost of gas-making materials or labour permitted. As approximately 4 gallons of gas oil are used in making 1000 c.ft. of mixed coal and water gas in the proportions produced by the Companies embraced in the Consolidated system, this reduction of 6 c. per gallon will permit of a reduction in the charge for gas of approximately 25 c. per 1000 c.ft., other factors of operating costs remaining the same. The Companies therefore expect to be able to file with the Public Service Commission a new rate schedule putting into effect, as from Aug. 1, of a rate not exceeding $1.25 per 1000 c.ft., in place of the $1.50 rate now operating. The quantity of oil that was contracted for at the high price last December, for the first six months of the present year, was based upon the requirements for the corresponding period of 1920. The unusually mild temperature prevailing during the past winter, however, decreased substantially the quantity of oil used, and so the total gallonage of oil involved in the present contract will not have been consumed, according to present estimates of the engineers, until late in July.

Evesham Gas-Works Restarted.—A supply of coal having come to hand, the Evesham Gas-Works, which have been unable to give a supply of gas for two weeks, have restarted. A restricted supply of gas is now available.

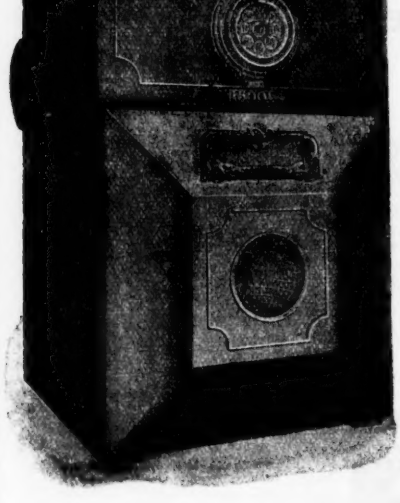
Bahia Blanca Gas Company, Ltd.—The report which will be presented at the annual meeting on Thursday of next week states that, with the debit brought forward from 1919, there is a total debit balance of £42,857. The past year has seen by far the highest average prices for all classes of combustibles; and but for the technical skill of the Manager (Mr. A. M. Hunter), the results would have been affected to a greater degree. Following upon the successful use of the generator referred to in previous reports, a plant on the same lines, of sufficient capacity to handle the total gas make, is being constructed. Increased prices for public lighting and railway supplies have been charged during the year. Negotiations with the object of raising the price for private lighting were inaugurated in May, 1920; but so far the Municipal Council have not been in a position to give formal sanction to the new rates. In the meantime, however, certain increases have been made in the charges for gas as from Feb. 1 last. The latest reports as to general prospects in Bahia Blanca are to the effect that export trade has slackened, because of the general slump and the action of the Argentine Government in fixing an unacceptable minimum price for the export of wheat.

Outcrop Coal-Seam at Birstall.—The Birstall District Council have secured mineral rights on their housing site, where an outcrop of coal-seam has been found; and the gas-works are to have second priority in receiving this coal, after needy households have been supplied. Traces of the coal were noticed some weeks ago; but digging operations by people of the district had to be stopped, as the Council, while owning the housing site, had not control over the mineral rights. The holders of the rights (the Trustees of Trinity College, Cambridge) have now given consent to coal-getting in the present emergency; and the Council have put fifteen of their employees on to the work.

Opposition to the Dublin Gas Bill.—An explanation was requested at a meeting of the Rathmines (Dublin) Urban Council of a minute as to a visit of the Chairman and Town Clerk to London to oppose the Bill being promoted by the Alliance and Dublin Consumers' Gas Company. It was stated that this action was taken without the approval of the Council. The Chairman (Mr. Wm. Ireland, J.P.) replied that the matter was urgent, and, as there was no time to call the Finance Committee together, it was decided that he and the Clerk should go at once. Dr. Jackson said the position was that an original inquiry was held in regard to this Bill, at which the Council were represented. The Dublin Corporation then asked the Finance Committee of the Rathmines Council to join them in opposition; but it was found that the Corporation would not go any further, and at this stage the Finance Committee decided to continue the opposition on their own behalf. The Chairman said the Finance Committee endeavoured to arrive at a compromise with the Company, but failed. The difference between the proposals of the Company and what was demanded by the Committee was so great that they could not come to an agreement. He reminded the members that the Kingstown and Blackrock Councils had also opposed the Bill.

Nottingham Gas Supply.—General satisfaction has been expressed in Nottingham that, under the conditions involved by the coal strike, it was rendered possible, through Mr. John Wilkinson's arrangements, to reduce to a minimum the public inconvenience necessarily involved. The curtailed supply, while inevitably affecting lighting, was so arranged that the maximum of power for motive purposes was afforded to factories dependent upon gas-engines. There was, it goes almost without saying, plentiful grumbling at the "cuts" which it was found necessary to impose in regard to the service; but, compared with the electricity department, wherein there was left much to be desired, the gas department's arrangements give little cause for criticism. At their meeting on Friday, the Gas Committee decided that there should be no further restrictions upon the existing supply; and this arrangement is one which has afforded much satisfaction locally, demonstrating the efficiency of the plans devised. The necessity for shortening the hours of labour at the chief carbonizing stations had given rise to some concern upon the part of the men; and a deputation in relation to the matter was received at Friday's meeting, when an assurance was given that no outside hands would be brought in while the Corporation's present workmen are on short time.

BRADDOCK'S LARGE GAS METERS



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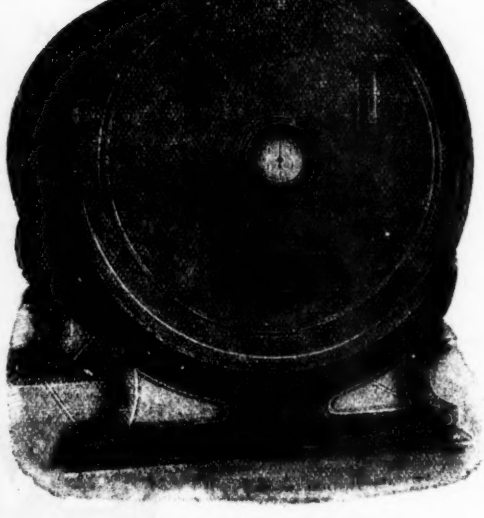

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Gas Manager's Narrow Escape.—Mr. David Young, the Manager of the Clones (co. Monaghan) Gas-Works, had a narrow escape from gas poisoning while engaged in locating a leak at the works. A helper noticed Mr. Young fall forward into a dangerous place, and dragged him out, only to find that he was unconscious. Medical assistance was procured, and fortunately Mr. Young soon recovered.

Curious Case of Gas Poisoning.—A singular case of gas poisoning is reported from Wolverhampton. A middle-aged woman named Martha Henshaw was found dead with her head in the gas-stove, and her feet under the sink. It transpired that she suffered from a nervous breakdown, and the supposition is that she went downstairs to try to turn off the water from a defective tap. Getting wet in the effort, she went, it is surmised, to the gas-stove to warm herself, which she had done frequently since the coal shortage. The Coroner accepted this view, and returned a verdict of "Accidental death," remarking upon the singular character of the circumstances.

Gas Company Aid Council.—In the quarterly report of the Gas Committee of the Bridgnorth Town Council, it was stated that at the commencement of the coal stoppage they had unfortunately only a small reserve of coal; and the supply of gas in the town must have failed, but for the timely and neighbourly aid of the Wolverhampton Gas Company, who had assisted them very generously.

Taking Money from his own Meter.—A man named Arthur Clark was charged at Tottenham with being drunk and disorderly, and was further accused, on his own confession, with stealing 10s. 5d. from the gas-meter at his house. According to the evidence, he broke open the meter, and spent the 10s. 5d. in drink. Afterwards he went to a policeman and told him what had happened. He insisted on being arrested. Mr. Davies, an inspector of the Gas Company, said they could not charge the man. He was under contract to pay for the gas consumed at his house; and the money he had taken would have to be repaid by him. The Magistrate remanded Clark on bail.

STOCK MARKET REPORT.

LAST week probably holds the record—or very nearly so, if not quite—for quietude of business on the Stock Exchange. All the old crushing factors were in full blast; and these were now supplemented by the counter attractions of the Derby week. It was again remarked that some markets might almost be regarded as closed.

The gilt-edged market was generally dull. In Home Government issues, among the big four, only Funding could maintain its position; prices on Friday being as follows: Consols 45⅝-46¾, War Loan 87⅝-88⅛, Funding 71½-72, Victory 77 13/16-78¼. Bonds fell away almost daily, and Indian were weaker. Corporations were rather more fortunate. Canadians rather improved on the whole, but Argentines were irregular.

The Foreign Market had some good points, Argentine, Brazilian, Chinese, and Japanese finishing well.

In the Miscellaneous Market, Rubber and Oil both improved, though the rise was later checked by some considerable amount of profit-snatching.

Business in the Gas Market was again on a very limited scale, but about as much as could be expected in such a week of general quietude. The generally prevailing characteristic was steadiness, and changes in quotation were very rare. In the London companies, the only alteration was a rise of ⅛ in South Metropolitan—a meticulous variation rather rare nowadays. In Suburban and Provincial, Wimbledon and Newcastle underwent promotion. In Continentals, Imperial Continental fell away from 139 to 132, with a drop of 7½ in the quotation. European was steady—Primitivas were hardly noticed.

Bargains done for cash during the week were as follows: On Monday, Bournemouth 5 p.ct. 7, ditto "B" 8⅝, British 22½, Commercial 4 p.ct. 54⅜, Croydon "A" 124, Gas Light ordinary 56, ditto preference 59, ditto debenture 49, Imperial Continental 135, 137, 138, 139 (and exceptional 125, 137½), River Plate debenture 38¼, South Metropolitan 67, 67½, 67⅝, 68, Southgate and District 5 p.ct. preference 64. On Tuesday, European 7, Gas Light ordinary 56, 56⅜, ditto debenture 49, Imperial Continental 135, 136½, 137 (and exceptional 112½), Primitiva 7s., ditto preference 27s., Sheffield "C" 58¾, South Metropolitan 68, Southgate and District 5 p.ct. preference 65. On Wednesday, Brentford preference 70, Commercial 4 p.ct. 53, 53½, Gas Light ordinary 56, 56½, ditto debenture 49, Ilford "A" and "C" 77½, 78, Imperial Continental 135 (and exceptional 135), Monte Video 63, San Paulo preference 5½, ditto debenture 35, South Metropolitan 68½, 68⅝, ditto debenture 47⅝, Wandsworth and Wimbledon 60¾. On Thursday, Gas Light ordinary 56, 56⅝, ditto maximum 42½, 43½, Imperial Continental 133 (and exceptional 134), Malta and Mediterranean 37s. 6d., South Metropolitan 68, South Suburban debenture 73, 74½, 74¾, 75, Tottenham "B" 53, Wandsworth New 57½, 57⅝, 58, ditto Wimbledon 60, Woking District 7½ p.ct. debenture, 1936 100. On Friday, Brentford preference 71, 71½, Derby 64, Gas Light ordinary 56¼, 56½, 56⅝, 56⅞, Imperial Continental 132 137½, Malta and Mediterranean 39s., South Metropolitan 68½, 68⅝, Tottenham "B" 54, Wandsworth New 57½, 57⅝.

In the Money Market, in the earlier part of the week the conditions were quite firm, but these soon relaxed and for the rest of the week the position was quite easy. Discount followed suit. Silver changed but little. The Bank rate is 6½ p.ct., as fixed on April 28.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue.	Share.	When ex-Dividend.	Ante-War Dividend & Bonus.	Last Dividend.	NAME.	Closing Prices, July 30, 1914.	Present Prices.	Lowest and Highest Prices of Bargains.
£			p.c.					
182,049	Stk.	Mar. 11	4	4%	Aldershot 4 p.c. Pref. .	...	53—58	...
1,551,868	,,	Apl. 14	2½	3⅛%	Alliance & Dublin Ord.	59—64	39—44	...
374,000	,,	Jan. 13	4	4%	Do. 4 p.c. Deb.	76—79	47—52	...
280,000	5	Oct. 28	7½	8%	Bombay, Ltd. . . .	5½—6½	4—4½	...
100,000	5	Feb. 25	16	5%	Bournemouth Gas { 5 p.c. . .	...	7½—8½	7
383,110	10	,,	7	7%	Bournemouth Gas { B 7 p.c. .	15—15½	8½—9½	8½
115,000	10	,,	6	6/-	and Water { Pref. 6 p.c.	13½—14	7½—8½	...
162,065	—	Dec. 30	—	4%	and Water { 4 p.c. Deb.	...	55—60	...
992,045	Stk.	Feb. 25	14	30/-	Brentford A Consolid. .	261—266	65—70	...
734,920	,,	,,	11	26/3	Do. B New . .	204—209	58—63	...
55,000	,,	,,	5	5%	Do. 5 p.c. Pref. .	109—111	68—73	70
221,400	,,	Dec. 15	4	4%	Do. 4 p.c. Deb. .	91—93	57—59	...
214,775	,,	Mar. 11	11	7½%	Brighton & Hove Orig. .	208—213	95—105	...
244,200	,,	,,	8	5½%	Do. A Ord. Stk.	154—159	65—75	...
1,287,500	Stk.	July 29	5	5%	Bristol 5 p.c. max. . .	...	...	...
530,000	20	Mar. 30	12½	10%	British	44—45	22—24	22½
120,000	Stk.	Dec. 30	4	4%	Do. 4 p.c. Deb. Stk.	88—90	50—55	...
245,771	,,	,,	4	4%	Buenos Aires 4 p.c. Deb.	85—87	37—40	...
100,000	10	May 27	—	6%	Cape Town & Dis., Ltd.	1½—2½	6½—7½*	...
100,000	10	Apl. 28	—	4½%	Do. 4½ p.c. Pref. .	4—6	4½—5½	...
100,000	Stk.	Dec. 30	4½	4½%	Do. 4½ p.c. Deb. Stk.	70—75	55—60	...
137,150	,,	Feb. 26	5	5%	Chester 5 p.c. Ord. . .	108—110	...	...
1,513,280	,,	Feb. 25	5/9/4	30/-	Commercial 4 p.c. Stk.	106—108	53—58	53—54½
560,000	,,	,,	5½	26/3	Do. 3½ p.c. do.	103—105	52—57	...
475,000	,,	Dec. 15	3	3%	Do. 5 p.c. Deb. Stk.	69½—71½	42—45	...
800,000	,,	Dec. 11	4	—	Continental Union Ltd.	76—79	20—25	...
200,000	,,	,,	7	—	Do. 7 p.c. Pref.	115—118	30—40	...
51,600	,,	Feb. 5	15	10%	Croydon A 10 p.c. . .	...	120—130	124
278,400	—	,,	12	7%	Croydon B and C 7 p.c.	...	95—105	...
492,270	Stk.	—	6	4⅛%	Derby Con. Stk. . .	123—125	...	64
55,000	,,	—	4	4%	Do. Deb. Stk. .	102—104	...	...
1,602,180	10	Jan. 29	10	5/0	European, Ltd. . . .	17½—18	6½—7½	7
16,298,975	Stk.	Feb. 10	4/17/4	30/-	Gas { 4 p.c. Ord. . .	98—102	56—58	56—56½
2,600,000	,,	,,	3½	26/3	Light { 3½ p.c. max. .	76—79	42—45	42½—43½
4,062,235	,,	,,	4	4%	and { 4 p.c. Con. Pref.	96—99	56—59	59
4,674,850	,,	Dec. 15	3	3%	Coke { 3 p.c. Con. Deb.	72½—74½	48—51	49
130,000	,,	Dec. 11	10	10%	Coke { 10 p.c. Bonds. .	...	...	...
82,500	,,	Mar. 11	5	3⅛%	Hastings & St. L. 5 p.c.	...	48—53	...
258,740	,,	,,	3½	2⅛%	Do. 3½ p.c.	87—89	34—39	...
70,000	10	May 12	11	5%†	Hongkong & China, Ltd.	16½—16¾	5—6	...
86,600	Stk.	Mar. 11	9	5⅝%	Hornsey 7 p.c. . . .	...	75—85	...
131,000	,,	Mar. 30	7½	3⅛%	Ilford A and C . . .	151—154	76—81	57½—58
65,780	,,	,,	6¾	2⅛%	Do. B	115—118	55—60	...
65,500	,,	Dec. 30	4	4%	Do. 4 p.c. Deb. . .	92—94	54—56	...
1,976,000	,,	May 27	9	5%†	Imperial Continental .	130—160	130—140*	132—139
1,235,000	,,	Feb. 10	3½	3⅛%	Do. 3½ p.c. Deb. Red.	84—86	76—81	...
235,242	,,	Mar. 30	6¾	3⅛%	Lea Bridge Ord. 5 p.c. .	119—121	65—70	...
2,498,905	,,	Feb. 26	10	37/6	Liverpool 5 p.c. Ord. { A.	211—213	...	...
						B.	146—148	...
306,083	,,	June 26	4	4%	Do. 4 p.c. Pr. Deb. Stk.	...	...	...
165,736	,,	Feb. 25	7/5/6	3⅛%	Maidstone 5 p.c. . .	...	52—57	...
75,000	5	June 11	6	5%	Malta & Mediterranean	4½—4¾	1½—2½	37/6—39/-
250,000	100	Apl. 1	4½	4½%	Met. of Melbourne { 4½ p.c. Deb.	99—101	88—93	...
541,920	Stk.	May 27	4	6%	Monte Video, Ltd. . .	11½—12	60—70*	63
1,875,892	,,	Feb. 25	4½	3⅛%	Newcastle & Gatsh'dCon.	98½—99½	59—61	...
529,705	,,	Dec. 30	3½	3⅛%	Do. 3½ p.c. Deb.	82—83	50—51	...
15,000	10	Mar. 11	—	8%	North Middlesex 10 p.c.	...	12½—13½	...
55,940	10	,,	7/14/0	5⅜%	Do. 7 p.c.	14—15	7½—8½	...
300,000	Stk.	May 12	8	8%	Oriental, Ltd. . . .	117—122	87—92	...
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd. . . .	7½—7¾	2—3	...
60,000	50	Feb. 25	13	7½%	Portsea Island, B . .	128—131	65—70	...
100,000	50	,,	12	6¾%	Do. C . .	118—121	50—55	...
249,980	5	April 29	8	—	Primitiva Ord. . . .	5½—6	1—1	7/-
499,960	5	June 26	5	—	Do. 5 p.c. Pref. .	4½—5	1½—1½	27/-
521,600	100	June 1	4	4%	Do. 4 p.c. Deb. .	91—93	65—67*	...
600,000	Stk.	Jan. 27	4	4%	Do. ,, ,, 1911	...	37—40	...
346,198	,,	Dec. 30	4	4%	River Plate 4 p.c. Deb.	85—87	37—40	38½
150,000	10	Mar. 30	6	6/-	San Paulo { 6 p.c. Pref.	10½—11	5½—6½	5½
125,000	50	Jan. 3	5	5%	San Paulo { 5 p.c. Deb.	47—49	35—40	35
135,000	Stk.	Mar. 30	10	5%	Sheffield A	223—224	62—64	...
209,984	,,	,,	10	4½%	Do. B	222—224	62—64	...
523,500	,,	,,	10	3½%	Do. C	220—222	59—61	58½
133,201	Stk.	Sept. 15	4	4%	Shrewsbury 5 p.c. . .	...	...	...
90,000	10	Sept. 30	9	9%	South African . . .	10½—11½	9—11	...
6,609,893	Stk.	Feb. 10	5/4/0	5%	South Met. Ord. . . .	111—113	67—69	67—68½
250,000	,,	Jan. 13	—	5%	Do. Red. Pref. .	...	90—92	...
1,895,445	,,	,,	3	5%	Do. 3 p.c. Deb..	72½—74½	46—49	47½
224,820	,,	Feb. 25	8½	7½%	South Shields Con. Stk.	157—159	85—87	...
1,087,795	,,	,,	6	3⅛%	S'th Suburb'n Ord. 5 p.c.	114—116	58—63	...
368,837	,,	Dec. 30	5	5%	Do. 5 p.c. Deb. Stk.	116—118	72—77	73—75
647,740	,,	May 12	7½	3⅛%	Southampton Ord. . .	99—102	55—58	...
121,375	,,	Dec. 30	4	4%	Do. 4 p.c. Deb. Stk.	...	57—59	...
120,000	,,	Feb. 25	—	3⅛%	Tottenham { A 5 p.c. .	135—138	57—62	...
782,273	,,	,,	6	3⅛%	District { B 3½ p.c. .	115—117	50—55	53—54
181,255	,,	Dec. 15	4	4%	District { 4 p.c. Deb.	87—89	53—56	...
184,380	10	Dec. 30	5	—	Tuscan, Ltd. . . .	5—6	1—2	...
149,900	10	July 1	5	5%	Do. 5 p.c. Deb. Red.	93—95	45—50	...
236,476	Stk.	Feb. 25	5	3⅛%	Tynemouth 5 p.c. max.	108½—109	68—70	...
					Wandsworth, Wimbledon, and Epsom—			...
30,000	,,	Feb. 25	8½	47/6	Wandsworth A 5 p.c.	151—156	78—83	...
253,636	,,	,,	6½	32/6	Do. B 3½ p.c.	129—134	55—60	...
108,075	,,	,,	—	33/3	Do. C . . .	...	55—60	...
140,865	,,	,,	—	33/3	New Ordinary . . .	...	55—60	57½—58
352,000	,,	,,	6½	26/3	Wimbledon 5 p.c. . .	117—122	57—62	60—60½
98,000	,,	,,	6½	32/6	Epsom 5 p.c. . . .	121—126	55—60	...
88,416	,,	Dec. 30	3	3%	3 p.c. Deb. Stk. . .	66—69	40—45	...

* Ex Div. † Next dividend will be at this rate.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for June 1.]

Nos. 14,254 to 14,911.

BEACHAM, T. E.—"Means for measuring or indicating weights of given volumes of liquids." No. 14,551.
BEACHAM, T. E.—"Metering liquids." No. 14,552.
BEARDMORE & CO., LTD., W.—"Means for operating valves, &c., from a distance." No. 14,909.
BLOCK, A. S.—"Gas-mantle." No. 14,310.
BOHAR, V.—"Gas. &c., stoves." No. 14.395.
BOYD, A. J.—See Beacham. Nos. 14,551, 14,552.
CÉSAR, V.—"Thermo-dynamic gas-generating systems," No. 14,815.
COLEY, H. E.—"Gas-burners." No. 14,692.
DICKSON, D. H.—See Coley. No. 14.692.
DORAN, C. S.—"Multiple valves for fluids." No. 14,581
FRANCHIMONT, E.—See César. No. 14,815.
GARRETT, H.—See Block. No. 14,310.
HAMMOND, M.—"Gas-economizer." No. 14,888.
HEDLEY, T. J.—"Gas combustion furnaces for organic analysis." No. 14,262.
HELPS, G.—"Manufacture and distribution of gas." Nos. 14,605, 14,725.
HERRING, E.—"Pipe holdfasts for walls, &c." No. 14,322.
HEYES, W. A., and HEYES & CO., LTD.—Recording devices." No. 14.403.
ILLINGWORTH, S. R.—"Coking coal." No. 14,676.
JACKSON, P. R.—See Doran. No. 14,581.
M'CLURE, J.—See Beardmore. No. 14,909.
MARSHALL, F. D.—"Retorts for treatment of carbonaceous, &c., materials." No. 14,472.
MARTLEW, W. S.—"Combined boiler and griller head for gas-stoves, &c." No. 14,661.
POORE, P.—"Destructive distillation of wood, &c." No. 14,820.
RIGBY, T.—"Heat-regenerating systems of gas-producer plants, &c." No. 14,598.
RIGBY, T.—"Heating or cooling liquids or admixed solids and liquids in evaporative, &c., treatment." No. 14,599.
ROBERTS, A. A.—See Block. No. 14,310.
SANFTLEBEN, E. A. V.—"Remote control systems." No. 14,884.
SCHROEDER, R. W.—"Flow-meters." Nos. 14,771, 14,772.
SMITH, W.—"Light-economizer." No. 14,517.
SOUTH METROPOLITAN GAS COMPANY.—"Stoking-machines." No. 14,805.
UMPLEBY, F.—"Gas producers and/or retorts." No. 14,276.

Newbiggin Gas-Works Shut-Down.—Notice has been given by the Newbiggin Gas Company that, owing to the supply of coal being exhausted, the supply of gas will be discontinued until further coal becomes available.

Leeds and the Zoning and Grading Schemes.—The General Purposes Committee of the Leeds City Council last week recommended the rejection of a proposal by the Regional Gas Council as to the zoning and grading of gas-workers. Labour members of the Council, led by Alderman Frank Fountain, moved that the Committee's recommendation be referred back, and contended that the Committee were repudiating an agreement come to by a body of experts throughout the West Riding area. Alderman C. H. Wilson, defending the General Purposes Committee, said there had been no hurry, either by his Committee or by the Gas Committee, to bring down wages, despite the falling price of living. The labour amendment was defeated.

The salary of the Sidmouth Gas Manager (Mr. H. Burgess) has been increased from £300 to £350 per annum.

The Belfast Corporation Gas Committee have accepted the tender of Messrs. R. & J. Dempster, Ltd., at £125,500 for a new gasholder.

Mr. James A. Kinnen, of Dublin, Liquidator in the matter of the Ballybag (co. Monaghan) Gas Company, Ltd., is offering the property for sale by tender.

Among the estimates of expenditure of the Public Control Committee of the London County Council for the financial year 1921-22 are: Gas-meter testing, £21,685; and gas testing, £6940.

A verdict of "Accidental death" was returned at a Wolverhampton inquest on Martha Henshaw, aged 60, who was found dead with her head inside the gas-stove. A doctor who had attended the woman expressed the opinion that she went to turn on the gas, became giddy, and accidentally fell inside the stove.

The Clerk has reported to the Bilston Urban District Council that he has sent an objection to the Board of Trade against the application of the Bilston Gas Company for power to alter the quality of the gas supplied, and to raise the standard price to an amount exceeding 6s. per 1000 c.ft. He has asked to be heard further on the detailed objections of the Council. He mentioned that the price of gas is now 4s. 2d. per 1000 c.ft.

Moving the Gas Committee's minutes at the Leeds City Council meeting last week, Alderman W. Penrose-Green said a great deal of the net profit of £5803 (after writing-off £20,827 standing deficiency) had been secured by the excellent use made of residuals, combined with skilful management. The Committee's policy in securing the manufacture of petrol and benzole had an asset not generally known, but one which they had had "up their sleeve" for some time past.

Particulars will be found in the advertisement columns of this number of the "JOURNAL" of an offer by Messrs. Higginson and Co., No. 80, Lombard Street, London, E.C., on behalf of the Cardiff Gas Light and Coke Company, of an issue of £237,860 of 7½ p.ct. redeemable debenture stock. The stock is offered for subscription at par; and it is to be redeemed at par on July 1, 1931. The subscription list opens to-morrow [Thursday], and will close on or before the 15th inst.

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